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Volume 14 Part 1

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Instructions to Authors

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Papers will be accepted in the following categories:
(a) Plant systematics (Australian and horticultural groups); (b) Descriptive plant morphology, anatomy and ecology; (c) Obituaries, biography and history; (d) Bibliographic studies, book reviews; (e) Botanical illustrations; (f) Noteworthy horticultural contributions. Preference will be given to unpublished material of suitable standard not intended for publication elsewhere.

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Text references to publications should be indicated as follows: (Smith, 1959), (Smith, 1959, p. 127), Smith (1959) or Smith (1959, pp. 125-208). The final section of the paper, headed 'References', should include only those titles referred to in this way. It should be laid out as follows:

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Bentham, G. (1868). "Flora Australiensis", Vol. 4. (L. Reeve: London).

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Journal abbreviations must be consistent within a paper and authors are recommended to follow "Botanico-Periodicum-Huntianum". Journals not cited in B-P-H should be abbreviated to conform with this general pattern. The following abbreviations for Australian states should be used: WA, NT, SA, Qld, NSW, ACT, Vic., Tas.

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Citation of specimens

10-30 specimens should be cited for each species (or subspecific taxon), although this may be varied under certain circumstances. The author may decide whether or not to include dates of collections and the sequence, provided a constant pattern is adhered to throughout a paper.

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Correspondence

All correspondence concerning the journal should be addressed to:
The Director, Adelaide Botanic Gardens, North Terrace, ADELAIDE, South Australia 5000.

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ETHNOBOTANICAL FIELD NOTES FROM THE NORTHERN TERRITORY, AUSTRALIA

N. M. Smith

State Herbarium, Botanic Gardens,
North Terrace, Adelaide, South Australia 5000

Abstract

Ethnobotanical notes from some 29 Aboriginal language groups in the Northern Territory of Australia are reported. Information was collected during field studies between 1986 and 1989. Scientific and Aboriginal names, uses, localities and collection data are given for 318 taxa, representing 191 genera and 86 families.

Introduction

In the Northern Territory the recent increase in awareness of the importance of ethnobotanical studies has gone beyond simple anthropological interest. It has now been recognised that information on plant use is a very important part of our country's cultural heritage. However with the increasing dependence on European type foods, and the restriction of Aboriginal movement patterns, much of 'old time' plant uses are no longer actively practiced, and are today mostly only known by elderly Aboriginal people. In many instances the lack of dependence upon 'old time' ways has brought about a reduction in the knowledge of these plant uses. I have used here the term 'old time' for knowledge held by Aboriginal people prior to European contact. Many Aboriginal people feel that culturally it is extremely important that this information be recorded while knowledgeable informants are still alive and before knowledge on 'old time' plant use further declines. Sadly, too much has been irretrievably lost.

Despite a long term anthropological and botanical interest in the Northern Territory, dating back to last century, the literature on Aboriginal plant usage has been relatively poor. In Central Australia a number of papers by Cleland & Johnston (1933), Sweeny (1947), Cleland & Tindale (1959) and Cleland (1966) all covered Aboriginal plant use to varying extents. More recently Gould (1969), Silberbauer (1971), Peterson (1977, 1978), Henshall et al. (1980), Kalotas (1980), Latz (1982), O'Connell et al. (1983), Institute of Aboriginal Studies (1988) have added to the information available on 'old time' and contemporary Aboriginal plant use in Central Australia.

In the tropical Northern Territory a recent succession of papers by Dunlop et al. (1976), Levitt (1981), Smyth & Von Sturmer (1981), Scarlett et al. (1982), Merlan & Rumsey (1982), Altman (1984), Chaloupka & Giuliani (1984), Galpagalpa (1984), Davis (1985), Russel-Smith (1985), Rose (1987), Aboriginal Communities of the Northern Territory (1988), Wightman & Smith (1989), Smith & Wightman (1990), Smith (in press), Wightman et al. (1991) have all made valuable contributions to the field of ethnobotany. Works prior to these have been lacking with the exception of Specht (1958) who covered a major part of Arnhem Land.

In both areas there have been others who have collected or commented upon plant usage by Aboriginal people including school teachers, geologists, missionaries, botanists, healthworkers etc. Their information on the whole, however, has tended to be anecdotal and of limited use; Aboriginal people are generally described in their writings as having lived on yams, roots, seeds and fruits. A lot of the published works lack plant collection details such as accurate scientific names and/or voucher specimens. In the works reviewed very few cite any plant vouchers collected.

Little ethnobotanical work appears to have been carried out in areas where disruption to Aboriginal culture seems to be greatest. For instance, apart from Rose (1987) and Smith (in press) very little work has been carried out in the whole of the Victoria River District, where Aboriginal plant knowledge is fast disappearing. Moreover, ethnobotanical information has been collected in detail from only a handful of language groups throughout the Northern Territory, which is sad considering that over 30 different languages are widely spoken. There are many other languages which are spoken by only a few people.

This paper will add to the growing body of ethnobotanical knowledge of 'old time' and contemporary plant use by providing detailed studies from many different areas of the Northern Territory. It reports on a broad survey showing a range of Aboriginal plant uses from coastal areas, monsoonal vine thickets through to the more arid zones.

It is hoped that this information will be useful to botanists, linguists and anthropologists enabling them to build on and improve the information available. Hopefully more ethnobotanical knowledge will be written down in the appropriate Aboriginal language in future making it more relevant to Aboriginal people themselves.

Methodology

The information presented was collected during the period 1986 to 1989 whilst the author was employed to document medicinal plant use for the Bush Medicines Project, Northern Territory Department of Health and Community Services.

The data on plant use was collected by the case study approach. Methodology included a combination of interviews and both participant and non-participant observation.

Data was collected mainly in the field. The main sources of information were the older men and women who were generally considered by their own communities to be knowledgeable on Aboriginal plant use. As plants were encountered, field guides provided the information as they perceived it to be relevant; only data concerned with food, medicine and material culture have been incorporated into this paper. Plant uses that are not susceptible to incorporation in this manner, although concerned with Aboriginal cultural beliefs, have been omitted. The information was recorded in written form and on tape, and was later checked and transcribed by linguists and language consultants.

As ethnobotanical data was acquired, the plant in question was collected, identified and preserved. Voucher specimens for all taxa collected are lodged at the Northern Territory Herbarium (DNA). Those plants listed below without voucher specimens were often growing in locations where collections were not ethically possible or they were large trees that were inaccessible. Botanical nomenclature follows that of Dunlop (1990) with subsequent taxonomic changes incorporated. Aboriginal language and community names generally follow that of Black (1983). The orthographies follow those currently in use in the communities visited, which are often those being developed by the School of Australian Linguistics at Batchelor or the Summer Institute of Linguistics at Darwin. Language group boundaries and community locations can be located in Figure 1.

Observations

Plant medicines

Plants still play a very important role in the Aboriginal medical systems in the Northern

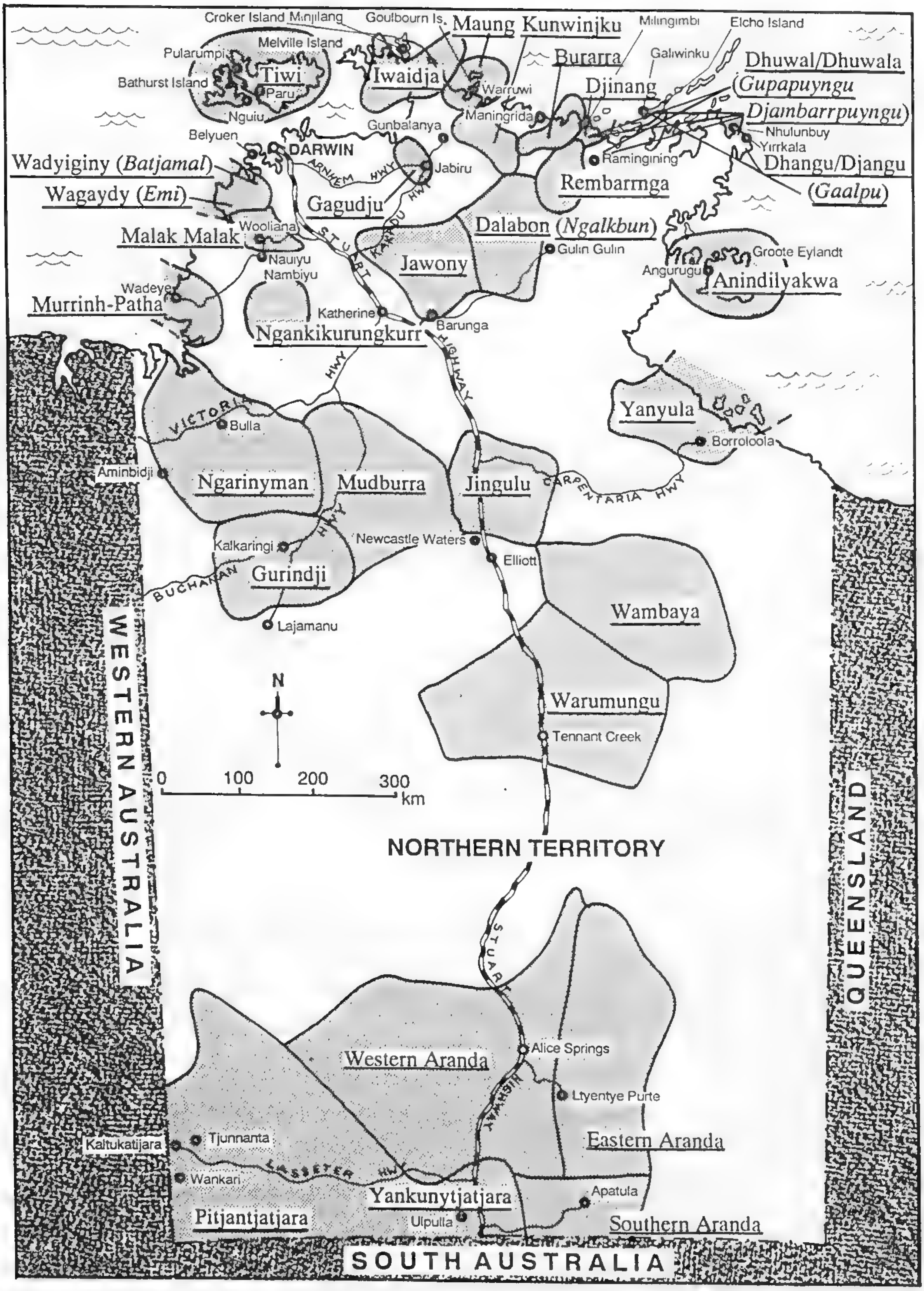

Fig. 1: Location of communities and language groups used in the text. (Language groups adapted from Wurm & Hattori 1981)

Territory today. They are however only one of the many forms of healing treatments available. Some of the others include the use of minerals, insect products, healing songs, the removal of foreign objects by knowledgeable people and western medicine available from health clinics and hospitals. The 164 plants utilised for their medicinal properties are listed in Appendix 1.

Plant medicines utilized come from a wide range of habitat types. Within each habitat type, there is a range of medicinal plants available to treat most sickness. Hence in times of need it becomes unnecessary to travel further afield to collect effective medicines.

The most common method of preparing medicines is by pounding or crushing fresh material then boiling in water. In 'olden times' before metal containers were available the plants would have been allowed to infuse in water in wooden bowls with perhaps hot stones added to help heat the water. The mixture is then drunk or used as a medicinal wash. Other common methods of preparation include crushing fresh material and inhaling the vapours, rubbing over the skin, direct application of sap onto the skin and the use of smoke as a healer and health promoter.

It appears that actual quantities of plants used are not always critical. Often measurements were given as ' about a handful', 'a few leaves' or 'a branch will do'. Similarly the amounts of water used were given in rough amounts, e.g. 'about one billy can' or 'just a little water'.

Of interest are the relatively large numbers of naturalised exotic species that are used as medicinal agents. These indicate that Aboriginal herbal medical systems are open to change and that people are still experimenting to find new and perhaps better cures.

This report does not deny nor affirm the efficacy of any of the plants used as medicines. Analysis of some constituents has recently been carried out by Collins (1990) and Aboriginal Communities of the Northern Territory (1988).

Plant foods

The gathering of plant foods is still a very important economic activity in most Aboriginal communities. In townships and communities most bush foods provide a supplement to foods purchased from the local store. However, for short periods those people living on outstations often have to rely upon their hunting and gathering skills for their survival.

Most of the foods reported here are fruits as they require less preparation, often being eaten raw. Foods that are less commonly utilised today include those species that require elaborate preparation. For example the availability of commercially produced flour has decreased the necessity to grind the seeds of native species. The 148 species utilised as foods can be found listed in Appendix 2.

Material culture

In the Northern Territory a large number of species are still used for purposes other than for food or medicines: 101 of these are listed in Appendix 3.

Apart from the use of material for ceremonial use, plants are gathered as raw materials for many purposes. Perhaps the most important is the collection of firewood. Most Aboriginal communities rely heavily on the burning of firewood for both cooking and heating. Many species can be utilised but most favoured seem to be the slow growing, denser hardwoods which produce a very hot fire, e.g. *Acacia aneura* var. *aneura*.

Many species are still collected for the manufacture of artefacts often for sale. Items include weapons such as shields, spears, woomeras ; ornaments such as carved animals, totem poles, bark paintings; and musical instruments such as digeridoos and clap sticks. Other commonly utilised plants include those gathered for making string, dyes and for tobacco.

Field notes

Of the vascular and non-vascular plants used by Aboriginal people 318 are listed alphabetically by botanical name below. Information given is ordered as follows: scientific name (italics), author, family, usage information, Aboriginal names (in bold face) with the language name in parentheses, location and collection numbers. The collectors initials NMS & GMW refer to N. M. Smith and G. M. Wightman respectively.

An asterisk (*) denotes an introduced species.

Abrus precatorius L. Fabaceae

1. The red and black seeds are used to make ornamental necklaces. Often referred to as bush beads.
   Miringirrwa (Batjamal & Emi) Belyuen NMS 824, NMS 1033; **Yiringaning** (Djambarrpuyngu) Milingimbi GMW 3340 & NMS; **?**(Tiwi) Nguiu.

Acacia aneura F. Muell. ex Benth. var. ***aneura*** Mimosaceae

1. The hard wood makes excellent weapons i.e. woomera (a broad throwing stick with a notch at one end for holding a spear, giving increased leverage in throwing), boomerangs and barbs/hooks for spears.
2. The wood makes excellent firewood as it burns to a very hot fire.
3. Branches are laid on the ground to protect cooked meat from spoilage in the sand, especially larger game such as emu and kangaroo.
4. The seeds, once roasted on hot coals, are ground into a flour to make damper.
5. The red brown sap sucking scale insects which abound on these trees release an edible sugary exudate (often called honey dew). This sweet liquid can be sucked directly or branches can be soaked in water to make a sweet drink.
6. Wasp galls or 'bush apples' of around 2cm diameter are collected and eaten raw in the spring time.
7. The nests of the edible honey ant, *Melophurus bagoti* are often located deep under the ground near the base of these trees.
8. This species is often the host tree for edible mistletoe fruits i.e. *Lysiana murrayi* and *Amyema maidenii.*
   Wintalyaka (Yankunytjatjara) Ulpulla NMS 1164, NMS 1353.

Acacia aneura F. Muell. ex Benth. var. ***latifolia*** J. Black Mimosaceae

1. The white powder covering this shrub is an excellent source of resin. The leafy branches are collected, laid out on bare ground or on sheets and threshed. The powder is then collected into a heap and melted into a ball for later use. The resin is used as a bonding agent to join spears, add barbs to spears, for plugging holes in wooden artefacts and more recently as a cement for repairing holes punctured in the petrol tanks of motor vehicles.
   Minyura=tree, **Kiti**=resin (Yankunytjatjara) Ulpulla NMS 1372.

Acacia auriculiformis Cunn. ex Benth. Mimosaceae

1. The burnt bark ashes are mixed with commercially available chewing tobacco, *Nicotiana tabacum*, (this exotic species nowadays replaces the use of many native *Nicotiana* spp. as it is more readily available). The addition of ash frees the nicotine to make the tobacco more powerful (Watson 1983).
2. Logs and branches are used to cook some species of toxic yams (i.e. *Tacca leontopetaloides*) to make them edible.
   Mankarra (Batjamal), **Tji** (Emi) Belyuen NMS 810.
3. The leaves are steeped in water and the liquid along with a few softened leaves is rubbed over the skin as a cleansing wash for cuts and bad sores.
   Gayparl (Burarra/Djinang) Maningrida NMS 683.
4. The leaves are crushed between stones and are thrown onto the surface of fresh water holes as a fish poison.
   Manyarrngark (Kunwinjku) Maningrida NMS 633.
5. The legumes are rubbed vigorously onto the skin, with a little water, to produce a rich lather used to relieve itchy skin. It is especially good for skin that has been affected by the irritant hairs of some stinging caterpillars.
   Kanawarra (Ngankikurungkurr) Nauiyu Nambiyu NMS 449, NMS 958.
6. This species is considered a good shady tree to camp under.
   Gaypal (Djambarrpuyngu/Gupapuyngu) Milingimbi, **Manjimanji** (Iwaidja) Minjilang GMW ? & NMS.

Acacia estrophiolata F. Muell. Mimosaceae

1. The yellow inner bark is boiled in water and the liquid is used daily as a medicinal wash for open cuts, sores and as a treatment for scabies. A little of the root bark can also be added if desired.
2. The liquid, prepared as above, can also be splashed around the eye to help take away redness and relieve soreness.
3. This species is a source of an edible light coloured gummy exudate which is eaten raw as a sweet.
   Athenge (Eastern Aranda) Ltyente Purte NMS 318.

Acacia holosericea Cunn. ex G. Don Mimosaceae

1. The wood is strong and hard making an excellent hook on a woomera.
   Pawuya (Ngarinyman) Bulla NMS 931, NMS 955.
2. The leaves and pods are smashed and then thrown onto the surface of a fresh water hole to poison fish. The 'stunned' fish rise to the surface and can be easily collected and thrown onto the banks.
   Mangurla (Jingulu/Mudburra) Elliott NMS 689, NMS 987.
3. The fruits and in some cases the outer branchlets are rubbed with a little water to produce a rich soapy lather which is used to wash the hands, wash clothes and to clean itchy skin, especially if one has been stung by an insect.
   Mangurla (Jingulu/Mudburra) Elliott NMS 689, NMS 987.; (Jawony) Katherine NMS ?; **Kanawarra** (Ngankikurungkurr) Nauiyu Nambiyu NMS 232, NMS 450, NMS 959.
4. The seeds can be collected, ground on stones and made into a flour. The flour is made into a damper or flat bread, that is cooked on hot coals often protected or wrapped in large leaves such as those from *Nymphaea macrosperma*.
   Parrawi (Ngarinyman) Bulla.

Acacia kempeana F. Muell. Mimosaceae

1. This species is the favoured host of *Xyleutes* sp. (Order *Lepidoptera*) whose larvae 'witchetty grubs' develop in the roots of the shrub. The roots are dug up and the large

grubs (up to 10cm long) are eaten raw or lightly roasted in the fire. They are highly sought after and are a staple diet of many women and children.
Ilykuwara (Pitjantjatjara) Apatula NMS 1163; **Ilykuwara** (Yankunytjatjara) Ulpulla NMS 1352.

Acacia lysiphloia F. Muell. Mimosaceae

1. The leaves and branches are heated over hot coals and then rubbed or held tightly over sore muscles and joints for pain relief. This is especially good when one has been out hunting or walking all day and the muscles are sore and tight.
2. The resinous leaves of this species are boiled in water and the liquid is used daily as a medicinal wash to help relieve colds and influenza.
   Nungkurrja (Jingulu) Elliott NMS 982; **Mulurrmi** (Mudburra) Elliott NMS 694; **Pirrpung** (Ngarinyman) Bulla NMS 1100, NMS 1116 , NMS 1117.
3. Young children are 'smoked' or passed over a pit of smoking leaves and branches which have been mixed with a little termitaria(compacted particles forming the nest of termites) as a health promoter. This is an extremely important ritual in the management of health for infants.
   Nungkurrja (Jingulu) Elliott NMS 982; **Mulurrmi** (Mudburra) Elliott NMS 694.

Acacia multisiliqua (Benth.) Maconochie Mimosaceae

1. The leaves are crushed in the hands and the vapours inhaled to relieve congested nasal passages associated with colds and influenza. Nowadays the leaves are often boiled in water and the steam that is given off is used in the same fashion.
   ? (Burarra) Maningrida NMS 519.

Acacia oncinocarpa Benth. Mimosaceae

1. A small handful of leaves is boiled in water and the liquid is drunk to relieve bad chest infections such as tuberculosis.
   Muriningyi (Tiwi) Pularumpi NMS 1257.

Acacia pellita O. Schwarz Mimosaceae

1. The fruits are rubbed over the skin with a little water to produce a cleansing lather. It is especially good for relieving itchy skin that has been affected by the irritant hairs of some 'stinging' caterpillars.
   Kanawarra (Ngankikurungkurr) Nauiyu Nambiyu NMS 448, NMS 957.

Acacia spondylophylla F. Muell. Mimosaceae

1. One old man said the leaves were boiled in water and the liquid was sipped to provide relief from colds and influenza. (This information needs checking).
   Imaranka-imarangka (Pitjantjatjara) Kaltukatjara NMS 614.

Acacia tetragonophylla F. Muell. Mimosaceae

1. The root bark can be used as a bandage for broken arms. Wrapped around the limb it aids in the healing process.
2. The root bark is crushed and boiled in water to produce an antiseptic wash for bad sores of the skin.
3. The pungent phyllodes are inserted around the base of a wart until bleeding starts, they are then removed. After 4-5 days the wart withers.
   Arlketyerre (Eastern Aranda) Alice Springs NMS 610; **Wulka pulka** (Pitjantjatjara/Yankunytjatjara) Apatula NMS 1201.

Acacia victoriae Benth. Mimosaceae

1. This species is a host of *Xyleutes* whose larvae 'witchetty grubs' develop in the roots of the shrub. The root is dug up and the grubs are eaten raw or lightly roasted, often discarding the head.
Minilyi (Jingulu), **Mininmi** (Mudburra) Elliott.

Adansonia gregorii F. Muell. Bombacaceae

1. The wood from the large trunks is used to carve coolamons.
2. The old discarded staminal column from the flower is used as a paint brush.
3. The fruits are used for carvings. Drawings are scratched on the outside which is then lightly sanded to remove the outer surface of short light brown hairs.
4. The inside pith of the fruit is eaten raw or if it is a little hard it can be added to water with a little sugar to make a thirst quenching drink.
5. A little of the old dry pith in the fruit also settles an upset stomach, working like an antacid treatment.
Jamulang (Ngarinyman) Bulla NMS 766, NMS 906, NMS 1106.

Aegialitis annulata R. Br. Plumbaginaceae

1. The leaves are folded in half and are blown to produce a whistle sound.
Widjber (Batjamal/Emi) Belyuen GMW 4528 & NMS.
2. No use recorded. Small shrub that grows on rocks near the water edge.
Mungu<u>n</u>mungu<u>n</u> (Djambarrpuyngu) Milingimbi GMW 700.

Aegiceras corniculatum (L.) Blanco Myrsinaceae

1. Leaves are placed over hot coals to produce smoke; babies are held in this smoke to make them strong.
2. The wood is used to manufacture implements, such as axe handles and digging sticks.
Derra (Emi) Belyuen NMS 813.

**Agave sisalana* Perrine Agavaceae

1. The large leaves are squeezed to remove sap, stripped of thorns and dried in the sun. The mass of white fibre left is rolled and plied into a strong rope or string which is used to manufacture dilly bags. This species is not native and has no aboriginal name. The use was introduced to the Emi and Batjamal people by the Chinese early this century. (Pers. comm. Marjorie Bil Bil). It is possibly a native of Mexico where it is cultivated for fibre production (Gentry 1982).
? (Batjamal/Emi) Belyuen.

**Agave* sp. Agavaceae

1. The fleshy stems are heated over a fire and the sap from the stems is placed into the ear to help reduce weeping and to relieve the pain of an ear-ache. This is not a native species and thus has no specific Aboriginal name.
? (Gaalpu/Kunwinjku) Warruwi NMS 142 & GMW.

Alloteropsis semialata (R. Br.) A. Hitchc. Poaceae

1. The rhizomes are used to scoop out honey from wild bee nests. The honey is sucked off but the rhizome is not necessarily eaten.
2. The root is the favoured food of the kangaroo.
Mbuka (Burarra) Maningrida NMS 534; **<u>L</u>äwarr** (Djambarrpuyngu) Milingimbi GMW 3468 & NMS.

3. A grass like plant. No use given.
Bijurrunku (Jingulu) Elliott.

Alphitonia excelsa (Fenzl) Benth. Rhamnaceae

1. The leaves are rubbed together with a little water to produce a skin cleansing lather.
2. In the past the bark has been used medicinally to treat aches and pains in the joints. Possibly it is no longer used today.
Minjirrajirda (Burarra) Maningrida NMS 643; **Gulu** (Djambarrpuyngu) Milingimbi GMW 4371 & NMS; **Mitjirribya** (Emi) Belyuen NMS 831, NMS 1039; **?** (Iwaidja) Minjilang NMS 150 & GMW.

Alstonia actinophylla (Cunn.) Schumann Apocynaceae

1. The trunks provide an excellent source of wood to make sea-going canoes.
Tjentjek (Batjamal), **Thender** (Emi) Belyuen NMS 830.

Amorphophallus galbra Bailey Araceae

1. The tuber is edible only after thorough pounding and cooking. If eaten raw it will 'burn your mouth out.'
Melngmelng (Batjamal), **Mimi** (Emi) Belyuen NMS 827, NMS 878; **Luwiya** (Djambarrpuyngu) Milingimbi GMW 3349 & NMS, GMW 3449 & NMS.
2. A flowering specimen collected was reported as being poisonous ('devil plant'), even after preparation.
Wurl wurl (Emi) Belyuen GMW 3449 & NMS.

Amorphophallus paeoniifolius (Dennst.) Nicholson Araceae

1. The tuber is smashed and boiled in water and the liquid is used as a medicinal wash to treat general sickness of unknown causes.
? (Tiwi) Nguiu GMW 3579 & NMS.

Ampelocissus acetosa (F. Muell.) Planchon Vitaceae

1. The fruits are eaten raw when ripe (black). They are considered a 'bit cheeky' or hot but are eaten with relish.
Bertjerwungat (Batjamal), **Kurrabiya** (Emi) Belyuen NMS 838, NMS 1061; **Wuluymung** (Djambarrpuyngu) Milingimbi GMW 3333 & NMS; **?** (Malakmalak) Wooliana NMS 397; **Mi mangkamurr** (Murrinh-Patha) Wadeye NMS 498; **Makurin** (Ngarinyman) Bulla NMS 921; **?** (Tiwi) Darwin NMS 1019.

Ampelocissus frutescens Jackes Vitaceae

1. The fruits are eaten raw when ripe (black).
Makulkul (Dalabon) Barunga NMS 353; **?** (Jawony) Katherine NMS 364.

Amyema bifurcatum (Benth.) Tieghem Loranthaceae

1. The inner wood is boiled in water and the liquid is sipped to provide relief from bad colds. Use as often as required till cured.
Jinirran (Jawony/Mayali) Gulin Gulin NMS 235.

Amyema maidenii (Blakely) Barlow ssp. *maidenii* Loranthaceae
1. The fruits are eaten raw when ripe, they are considered to be very sweet.
   Parka-parka (Yankunytjatjara) Ulpulla NMS 1356.

Antiaris toxicaria Lesch. Moraceae
1. The inner bark is pounded and dried, re-softened in the mouth and rolled between the palms into string. The string is often used to make dilly bags.
   Barrata (Djambarrpuyngu) Milingimbi GMW 3476 & NMS.

Antidesma ghaesembilla Gaertner Euphorbiaceae
1. The fruits are eaten raw when ripe (red).
   ? (Dalabon) Barunga NMS 559; **Warranuwa** (Djambarrpuyngu) Milingimbi GMW 3463 & NMS; ?(Jawony) Katherine NMS 884; **Pirliming** (Ngarinyman) Bulla NMS 926.

Arenga australasica (H.H. Wendl. & Drude) S.T. Blake Arecaceae
1. The heart or growing tip of this palm can be eaten raw or after it has been lightly roasted on hot coals or boiled in water.
2. This palm has special significance to some people in the Maningrida area and by them is called the "wind dreaming tree". It has special powers that controls all strong winds, especially cyclones.
   An-jardarrk (Burarra) Maningrida GMW 3864 & NMS.

Asteromyrtus symphyocarpa (F. Muell.) Craven Myrtaceae
1. Fresh young leaves (and sometimes a few roots) are boiled in water and the vapours inhaled and a little of the liquid sipped for relief from sore throats, bad coughs, colds and influenza. Use 2-3 times daily until cured.
   Mawilyaburna (Anindilyakwa) Angurugu NMS 212.
2. Fresh leaves are crushed in the hand and the vapours inhaled for relief from any sinus trouble.
3. Fresh leaves are used when cooking meats and vegetables as a herb flavouring.
   Yerrwupundudup (Ngankikurungkurr) Nauiyu Nambiyu NMS 444, NMS 1022, NMS 1349.

Atalaya hemiglauca (F. Muell.) F. Muell. ex Benth. Sapindaceae
1. The leaves and branches are crushed between stones and thrown onto the surface of fresh water holes as a fish poison. The 'stunned' fish rise to the surface and can be easily collected and thrown onto the banks.
   Jakilirra (Jingulu) Elliott NMS ?; **?** (Ngarinyman) Bulla NMS 1125.

Avicennia marina (Forsskal) Vierh. Avicenniaceae
1. The thin green bark is placed directly on to stingray stings. Small pieces can also be chewed or perhaps softened and spat out onto the sting. Both methods help relieve the pain and help to heal the injury.
   Manyarr (Djambarrpuyngu) Milingimbi NMS 507 & GMW.
2. The dry old wood is burned on the fire. The black charcoal remains are mixed with sea water to form a paste which is applied to ringworm, boils, sores or any other skin condition. Use daily till cured.
   Manyarr (Yolngu Matha) Yirrkala NMS 214.

3. Fresh green leaves can be applied to a fire to produce a thick black smoke used to signal neighbouring relations.
   Manyarr (Djambarrpuyngu) Ramingining NMS 660 & GMW.
4. The fruits are roasted on hot ashes then eaten.
   Mirirrwiny (Batjamal), **Thinbir** (Emi) Belyuen NMS 815, NMS 1034; **Manyarr** (Djambarrpuyngu/Gupapuyngu) Milingimbi NMS 507 & GMW.
5. The mangrove worms in this species are considered unpalatable.
   Manyarr (Djambarrpuyngu/Gupapuyngu) Milingimbi NMS 507 & GMW.
6. Mangrove tree, no use recorded.
   Mungunmungun (Djambarrpuyngu) Galiwinku NMS 175.

Bambusa arnhemica F. Muell. Poaceae
1. The culms are used as spear shafts. The tips are made from *Bruguiera gymnorrhiza.*
   Del (Batjamal), **Diye** (Emi) Belyuen.

Banksia dentata L.f. Proteaceae
1. The old inflorescence cones are used as a source of fire when travelling. The ends are burned and allowed to smoke. They will burn very slowly for 2-3 hours and can be used to light the fire at the next camp site. Burnt at night they will repell mosquitoes from around the camp site.
   Gulwbook (Rembarrnga) Maningrida NMS 663 & GMW.

Barringtonia acutangula (L.) Gaertner Lecythidaceae
1. The leaves stems and fruits are pounded with stones, then thrown out onto the surface of a fresh water hole as a fish poison. The fish rise to the surface and can be collected by hand easily.
   Miyaliny (Ngarinyman) Bulla NMS 746, NMS 909.
2. Not a good tree to camp under as it is often covered with caterpillars that, when touched, irritate the skin.
   ? (Kunwinjku) Gagadju NMS 1482.

Blennodia canescens R. Br. Brassicaceae
1. The stems are eaten raw as a vegetable.
   Mai=vegetable food (Pitjantjatjara/Yankunytjatjara) Apatula NMS 1167.

Boerhavia coccinea Miller Nyctaginaceae
1. The tuberous rootstock is edible after roasting on hot coals.
   Puunpa (Pitjantjatjara) Apatula NMS 1176; **Puunpa** (Yankunytjatjara) Ulpulla NMS 1355.

Bombax ceiba L. Bombacaceae
1. Sea going canoes are made from the trunk of this species.
2. The branches are used for carving artefacts and for making digeridoo's.
   Gulu' (Djambarrpuyngu) Milingimbi GMW 3435 & NMS.
3. The cottony fibres surrounding the seeds are used to stuff pillows.
   ? (Iwaidja) Minjilang NMS 158 & GMW.

Brachychiton diversifolius R. Br.. Sterculiaceae

1. The inner bark of this species is stripped from the tree, pounded and dried a little before it is used to make a very strong string or rope. The string is used to manufacture dilly bags, fish bags and fish nets. It is also used to tie bark paintings onto support sticks to stop them from warping.
   Burdaga (Burarra) Maningrida GMW 3859 & NMS; **Budbud** (Dalabon) Barunga NMS 341; **Nanungguwa** (Djambarrpuyngu) Milingimbi GMW 3489 & NMS; **Pirtpa** (Ngarinyman) Bulla NMS 728, NMS 745.
2. The inner bark is used as a bandage or gauze to cover cuts and open sores.
   Pirtpa (Ngarinyman) Bulla NMS 728, NMS 745.
3. The inner bark is stripped off the tree and chewed to provide a source of water, especially when walking overland on long trips during the dry season.
   Burdaga (Burarra) Maningrida GMW 3859 & NMS; **Budbud** (Dalabon) Barunga NMS 341.
4. Juvenile plants can be used as a general purpose medicine to combat influenza, fever or any unknown sickness. The leaves are pounded and soaked in water for up to 60 minutes.The liquid is then used as an all over body wash and a little is placed in each ear.
   Djambuwalngani (Djambarrpuyngu) Milingimbi GMW 3489 & NMS.
5. The fruits are roasted on hot ashes to remove the irritant hairs and to cook the seeds. The seeds are then picked out and eaten.
   ? (Batjamal/Emi) Belyuen NMS ?; **Pirtpa** (Ngarinyman) Bulla NMS 728, NMS 745; **?** (Tiwi) Pularumpi NMS 1269.
6. The clear gummy exudate from this species is placed directly onto sores and cuts to help them heal over.
   Pirtpa=tree, **Martiya**=gum (Ngarinyman) Bulla NMS 728, NMS 745.
7. The gum is also eaten as a sweet.
   Burdaga=tree, **Marndaja**=gum (Burarra) Maningrida GMW 3859 & NMS; **?** (Djinang) Maningrida GMW 3859 & NMS; **?** (Tiwi) Pularumpi NMS 1269.

Brachychiton megaphyllus Guymer Sterculiaceae

1. The ripe fruits indicate that it is the right time of year to hunt for baby shark, which is a prized food.
   ? (Gaalpu/Kunwinjku) Warruwi NMS 143 & GMW.
2. The fruits are roasted on hot coals to burn off the irritant hairs that surround the seeds. The seeds are then eaten tasting like popcorn.
   Nganwarra (Emi) Belyuen NMS 800.

Brachychiton spectabilis Guymer Sterculiaceae

1. The inner bark is used to make a string/rope used in the manufacture of dilly bags and fishing nets.
2. The fruits are roasted on hot ashes to remove the irritant hairs that surround the seeds. The seeds are then picked out and eaten.
   Jarrinykal (Ngarinyman) Bulla NMS 748.

Brachychiton sp. Sterculiaceae

1. The inner bark is used to make string or rope for dilly bags.
   Balgurr (Djambarrpuyngu) Milingimbi GMW 3467 & NMS.

Brachystelma glabriflorum (F. Muell.) Schltr. Asclepiadaceae

1. The rounded tuber is eaten raw or cooked either by roasting on hot coals or by boiling like a potato. According to local knowledge the small bell-shaped flowers always point to where the next plant is growing so it is easy to find more when flowering.
   Badju (Dalabon/Nalkbun), **Djalwak** (Jawony) NMS 340.

******Brassica tournefortii* Gouan Brassicaceae

1. The root stock is edible after roasting. This is not a native species.
   Wana wana (Pitjantjatjara) Apatula NMS 1178.

Bruguiera gymnorrhiza (L.) Savigny Rhizophoraceae

1. The timber of this species is durable and hard. It is used to manufacture spear tips known as **batjagada** (Batjamal) and **ijinde** (Emi); the culms from *Bambusa arnhemica* are used as shafts.
   Benmerr (Batjamal), **Kunyme** (Emi) Belyuen NMS 814.

Bruguiera parviflora (Roxb.) Wight & Arn. ex Griffith Rhizophoraceae

1. This species is considered a good tree to find mangrove worms in, unlike those found in *Avicennia marina* which are considered unpalatable.
   Godu (Djambarrpuyngu) Milingimbi GMW 726.

Buchanania obovata Engl. Anacardiaceae

1. The inner wood is boiled in water and the liquid used as a mouthwash for toothache and as an antiseptic wash for sores and cuts of the skin.
   Munydjutj (Djambarrpuyngu) Galiwinku NMS 173; **Munydjutj** (Yolngu Matha) Yirrkala NMS 176.
2. The bark is chopped off the tree and is boiled in water. The liquid is strained and used as a wash for infected sores, weeping cuts and as an effective treatment for prickly heat.
   Bigigee (Yanyula) Borroloola NMS 1243.
3. The young stems are heated on hot coals and chewed directly onto sore teeth or the ends can be sharpened and the point inserted into a tooth cavity for relief from toothache. In some cases the larger petioles and central leaf vein can be used for the same purpose.
   Mangkarrkba (Anindilyakwa) Angurugu NMS 208; **Mulugi** (Burarra), **Yulwandi** (Djinang) Maningrida NMS 644 & GMW; **Munydjutj** (Djambarrpuyngu) Galiwinku NMS 587; **Munydutj, Dhurrpinda** (Djambarrpuyngu) Milingimbi GMW 3331 & NMS.
4. The fruits are eaten raw when ripe; they are often collected from the ground.
   Mangkarrkba (Anindilyakwa) Angurugu NMS 208; **Kanmalhal** (Batjamal), **Wurrngin** (Emi) Belyuen NMS 806; **Mulugi** (Burarra), **Yulwandi** (Djinang) Maningrida NMS 644 & GMW; **Munydjutj** (Djambarrpuyngu) Galiwinku NMS 173, NMS 587; **Munydjutj, Dhurrpinda** (Djambarrpuyngu) Milingimbi GMW 3331 & NMS; **?** (Gaalpu/Kunwinjku) Warruwi GMW 3165 & NMS; **Gurumal** (Jawony) Barunga; **?** (Murrinh-Patha) Wadeye NMS 494; **Ngari-ngari** (Ngarinyman) Bulla NMS 739; **?** (Rembarrnga) Gulin Gulin NMS 242; **Bigigee** (Yanyula) Borroloola NMS 1243; **Munydjutj** (Yolngu Matha) Yirrkala NMS 176.

Callitris intratropica R. Baker & H.G. Smith Cupressaceae

1. The red sticky inner bark is pounded and boiled in water. The liquid is applied as an antiseptic wash for sores and cuts. Use about 4-5 square inches of bark in one half a billy of water. Sections of the outer bark can also be used as bandages and as splints for broken arms.
   Katanj (Jawony) Barunga NMS 334; **Manlarr** (Kunwinjku) Jabiru NMS 1471; **Munlarrk** (Rembarrnga) Maningrida NMS 662 & GMW.
2. The liquid prepared as above can also be used as an all over body wash and some of the outer bark tied around the abdomen as a cure for diarrhoea.
   Lanapu (Djambarrpuyngu) Galiwinku NMS 582.

Calophyllum inophyllum L. Clusiaceae

1. The large round seeds are used by children as marbles and as projectiles in slingshots.
   ? (Tiwi) Pularumpi NMS 1276.

Calytrix brownii (Schauer) Craven Myrtaceae

1. Fresh leaves are boiled in water. The vapours given off are inhaled to clear the head and unblock the sinus and to relieve the symptoms of colds. A little of the mixture can be sipped to help relieve any internal pain associated with influenza.
   Alungkwaluwa (Anindilyakwa) Angurugu NMS 207.

Calytrix exstipulata DC. Myrtaceae

1. Fresh branches are placed on a fire and allowed to smoulder. They then smoke all night repelling all mosquitoes from around the camp site.
   Mun-giji (Burarra) Maningrida NMS 531, GMW 3897 & NMS.

Camptostemon schultzii Masters Bombacaceae

1. Old drift wood of this species is burnt and the ashes are rubbed onto skin disorders such as blotchy skin, fungal infections, scabies and leprosy. A mixture of ash and water may also be applied to childrens knees if they are slow to begin walking.
2. The timber is very light but durable and is used to manufacture canoes and floats.
   Wuduku (Djambarrpuyngu) Galiwinku NMS 164; **Wuduku** (Djambarrpuyngu) Milingimbi NMS 1065 & GMW; **Wuduku** (Djambarrpuyngu) Ramingining NMS 658 & GMW.

Canarium australianum F. Muell. Burseraceae

1. The trunk is used to make sea going canoes.
   ? (Yanyula) Borroloola.
2. The fruit is collected from the ground, cracked open and the seed eaten raw.
   Bine (Batjamal), **Kunarra** (Emi) Belyuen NMS 819, NMS 1032; **Deti** (Djambarrpuyngu) Milingimbi GMW 3485 & NMS.

Canavalia rosea (Sw.) DC. Fabaceae

1. This twining creeper often grows up over shrubs to create a good place to camp under; plenty of shade.
2. The seeds are used as beads when making necklaces.
   ? (Ngarinyman) Bulla NMS 750.

Canthium latifolium F. Muell. ex Benth. Rubiaceae

1. The fruit is eaten raw when ripe (red); it tastes sweet and is highly sought after.
   Awalyura (Pitjantjatjara) Apatula NMS 1180.

Capparis lasiantha R. Br. ex DC. Capparaceae

1. The whole fruit is eaten raw, including the seeds; when ripe it tastes very sweet and is a highly sought after food.
   Babingi (Mudburra) Elliott NMS ?; **Pampilyi** (Ngarinyman) Bulla NMS 925.

Capparis umbonata Lindley Capparaceae

1. A good handful of bark with a few leaves added can be boiled in water to make a medicinal wash to cure sores of the skin, scabies and boils. Use a section of bark 2 - 3 x 10 - 15 inches in half a flour tin of water (about 25 litres).
2. The roots can also be boiled in water and the liquid used as a wash to provide relief from painful joints such as knees or hips. Keep the liquid away from the eyes.
   Burnayingmi (Jingulu), **Kurlinyaka** (Mudburra) Elliott NMS 698, NMS 989.
3. The fruit is considered good food; eaten raw when ripe.
   Tjiren (Emi) Belyuen NMS 840; **Burnayingmi** (Jingulu), **Kurlinyaka** (Mudburra) Elliott NMS 698, NMS 989.
4. As well as the fruit being a source of food this species has special ceremonial significance to the Ngarinyman people.
   ? (Ngarinyman) Bulla NMS 1074.

Carallia brachiata (Lour.) Merill Rhizophoraceae

1. Stem timber is used to manufacture axe handles.
2. The fruit is eaten raw when ripe (red).
   Muyu (Batjamal/Emi) Belyuen NMS 808.

Carissa lanceolata R. Br. Apocynaceae

1. A few roots are cleaned of all dirt, peeled, smashed and boiled in water. Some of the liquid is used as a mouth wash or some cotton wool soaked in the liquid placed over a sore tooth will relieve the pain of toothache. A hot compress soaked in the liquid may be held against the face to also relieve the pain.
   Manigudja (Yanyula) Borroloola NMS 1254.
2. The leaves and branches can be smashed and boiled in water and the liquid used as a warm body wash to provide relief from the symptoms of colds and influenza.
   Putpara (Ngarinyman) Aminbidji NMS 1143.
3. The fruits are eaten raw when ripe (soft and black). A very highly prized food.
   Kulyukulyumi (Jingulu) Elliott NMS 992; **Narmanburu** (Mudburra) Elliott NMS 700; **?** (Dalabon/Ngalkbun) Barunga NMS 469; **Putpara** (Ngarinyman) Aminbidji NMS 1143; **Putpara** (Ngarinyman) Bulla NMS 725, NMS 961; **Mangudja** (Yanyula) Borroloola NMS 1254.

Carpentaria acuminata (H.H. Wendl. & Drude) Becc. Arecaceae

1. The 'cabbage' (the soft flesh at the growing tip of this palm) is eaten raw, boiled or after roasting on hot coals. Roasted and smashed the flesh becomes soft, gluey and suitable to give to babies. It is very tasty and is highly regarded.
   Tjemel (Batjamal), **Merrwerr** (Emi) Belyuen; **Yirrigiyirrigi** (Kunwinjku) Jabiru.

Cassytha filiformis L. Lauraceae

1. The stems are burnt on the fire till black then they are rubbed on the hair as a form of black hair dye.
   Warnalang (Ngarinyman) Bulla NMS 933.
2. The fruits are eaten raw when ripe (clear/translucent). They are highly regarded as a food source.
   Burrun burrun (Burarra/Djinang) Maningrida GMW 3851 & NMS; **Tjelknganiny, Kalku** (Batjamal), **Tjirrkinin** (Emi) Belyuen NMS 839; **Burrun burrun** (Djambarrpuyngu) Galiwinku NMS 580; **Yarrngiyarrngi** (Djambarrpuyngu) Milingimbi GMW ? & NMS.

Casuarina equisetifolia Forster & Forster f. Casuarinaceae

1. Locally called the whistling tree; The sound made by the wind passing through the branches puts people to sleep at night.
   Djomula (Djambarrpuyngu) Milingimbi GMW 3518 & NMS.
2. This species has some important medicinal properties.
   Muwarraka (Anindilyakwa) Angurugu.

Cayratia trifolia (L.) Domin Vitaceae

1. The tuber is edible after roasting on hot ashes.
   Djalwa (Batjamal), **Nelerre** (Emi) Belyuen NMS 876.
2. The fruits are considered edible when ripe (black).
   Galun (Djambarrpuyngu) Milingimbi GMW 3478 & NMS.

Celtis philippensis Blanco Ulmaceae

1. The inner bark is boiled in water and the liquid is used as a medicinal wash to treat leprosy and to relieve conditions such as itchy skin and scabies.
   Naalij (Ngarinyman) Bulla NMS 753.

Chionachne cyathopoda (F. Muell.) F. Muell. ex Benth. Poaceae

1. The culms are used to manufacture spears.
   ? (Ngarinyman) Aminbidji NMS 1141.

Choiromyces aboriginus Trappe Terfeziaceae

1. This species of fungus is eaten raw or after roasting on hot ashes. It contains a lot of moisture and can be very thirst quenching.
   Witita (Pitjantjatjara) Apatula NMS 1197.

Cissus adnata Roxb. Vitaceae

1. The branches and leaves are considered toxic and should not be touched.
   Burr purr (Djambarrpuyngu) Milingimbi GMW 4375 & NMS.

Cleome viscosa L. Capparaceae

1. In the past this plant has been used medicinally.
   Karlwu karlwa (Jingulu) Elliott NMS 683, NMS 996.

Clerodendrum floribundum R. Br. Verbenaceae

1. The thickened tap root is edible after roasting. Considered an emergency food source. **Babirdirmi** (Jingulu), **Babirda** (Mudburra) Elliott.
2. The stems of this species are very straight and can be used as splints for broken arms. **Duttji** (Djambarrpuyngu) Galiwinku NMS 169.
3. The leaves and outer branchlets can be crushed and boiled in water and the liquid used as a body wash for relief from conditions such as itchy scaly skin, as an antiseptic wash for sores and cuts and as a very effective cure for bad diarrhoea when a little of the liquid can also be sipped.
   Molorrk (Dalabon/Jawony) Barunga NMS 333; **Butwatanganing** (Djambarrpuyngu) Milingimbi NMS 1066 & GMW; **Buwatananani** (Yolngu Matha) Yirrkala NMS 177.
4. The liquid prepared as above and used as a body wash will cure really bad headaches and a little splashed up into the eyes will help relieve tired sore eyes.
   Marbudala (Yanyula) Borroloola NMS 1256.
5. The vapours inhaled from boiling leaves in water will clear a blocked sinus. Some of the liquid sipped will help to relieve the symptoms of colds and influenza, especially the aches and pains in the joints and muscles. Also it will help to remove the build-up of phlegm from within the lungs to make breathing easier. Nowadays it is used by some smokers to help clear the lungs.
   Molorrk (Jawony) Katherine NMS 369, NMS 370.

Cochlospermum fraseri Planchon ssp. ***heteronemum*** (F. Muell.) Poppendieck Bixaceae

1. The tap root from young trees can be roasted on the fire and eaten. Considered more of a drought food as it is a bit tough.
2. The inner bark can be chewed to quench the thirst especially when walking long distances overland during the dry season.
3. The bark can also be stripped from the tree in large sections and used as splints and bandages, especially suitable for broken limbs.
4. The inner bark can be boiled in water and the liquid drunk to help bring down a high temperature. A few flowers can be added to increase the effectiveness.
5. The young fruits are squeezed and the yellow mucilage surrounding the seeds is applied to boils to help draw them out and heal them.
6. The cottony fibres surrounding the seeds have recently been used as a stuffing for pillows.
   Kalijpa (Ngarinyman) Aminbidji NMS 1153; **Kalijpa** (Ngarinyman) Bulla NMS 732, NMS 1104.

Codonocarpus cotinifolius (Desf.) F. Muell. Gyrostemonaceae

1. Edible grubs are found in the roots of this species.
2. The leaves can be crushed and rubbed over the body to relieve internal pain, colds, influenza and to help heal sores of the skin. Considered to be a very versatile medicine.
3. Kangaroos eat this plant during drought periods, especially after fire, to keep themselves fat.
   Kunturung, Kalutu (Pitjantjatjara) Apatula NMS 1202; **Kuntura[ng?]** (Yankunytjatjara) Ulpulla NMS 1378.

Convolvulus erubescens Sims Convolvulaceae

1. The tuberous rootstock is edible after roasting on hot coals.
   Anulytja (Pitjantjatjara) Apatula NMS 1177.

Corynotheca lateriflora (R. Br.) F. Muell. ex Benth. Liliaceae

1. The leaves and stems are used as a flavouring when cooking. Especially good for goanna, buffalo, emu and kangaroo.
   Bunbarr (Rembarrnga) Maningrida NMS 666 & GMW.

Corypha elata Roxb. Arecaceae

1. The centre growing tip of this palm or 'cabbage' can be eaten raw or roasted.
2. The large round seeds are used by children as marbles.
   Gul̲wirri (Djambarrpuyngu) Galiwinku, Milingimbi GMW 2476 & NMS, Ramingining GMW 683.

Crinum angustifolium R. Br. Liliaceae

1. The bulb is cleaned and smashed in water and allowed to soak for 24 hours (nowadays the boiling of the water is commonly carried out). The liquid is used as a medicinal wash for cuts, sores of the skin and as a cure for leprosy. Thin layers of the bulb are placed over cuts as an artificial skin covering.
   Adikalyuba (Anindilyakwa) Angurugu NMS 211; **Jajalkin** (Mudburra) Elliott NMS 956.
2. The bulb and a few leaves can be chopped and boiled in water and the liquid used as a medicinal body wash to relieve internal pain; especially good for pain in the joints such as knees or hips.
   ? (Jingulu/Warumungu) Elliott NMS 978; **Jajalkin** (Mudburra) Elliott NMS 956.
3. Some of the old people said the bulb from this species had medicinal use for some skin conditions whereas others said it was not a medicine.
   ? (Ngarinyman) Bulla NMS 914.
4. The whole plant is considered poisonous.
   Warrkarr (Djambarrpuyngu) Milingimbi GMW ? & NMS.
5. Goannas eat the seeds from this species to cure snake bites.
   ? (Ngankikurungkurr) Nauiyu Nambiyu NMS 1001.

Crotalaria eremaea F. Muell. var. *strehlowii* (E. Pritzel) A. Lee Fabaceae

1. The leaves are crushed on stones and then boiled in water. The liquid is used as a medicinal wash for relief from bad colds and internal sickness.
   Ulukulukka (Pitjantjatjara) Apatula NMS 1179; **Ulukulukka** (Yankunyjatjara) Ulpulla NMS 1369.

**Crotalaria goreensis* Guillemin & Perrottet Fabaceae

1. The orange seeds are used in necklaces. This is not a native species and has no specific Aboriginal name.
   Mulmu (= plant without woody stem) (Djambarrpuyngu) Milingimbi GMW 4335 & NMS.

Croton arnhemicus Muell. Arg. Euphorbiaceae

1. The inner bark is scraped and boiled in water(in the old days it was soaked but nowadays boiling is more common). The red liquid is used as a medicinal wash for sores and cuts of the skin, to relieve headaches and to reduce any swelling in the joints.
   Ngarrik (Batjamal/Emi) Belyuen NMS 795, NMS 1055, GMW 4515 & NMS.

Cucumis melo L. Cucurbitaceae

1. The fruit is eaten raw after rubbing off the white bloom on the outside of the skin.
   Mulmu (= plant without woody stem) (Djambarrpuyngu) Milingimbi GMW ? & NMS; **Wunbut, Karal** (Mudburra/Ngarinyman) Bulla NMS 1098; **Ulkuta** (Pitjantjatjara) Apatula NMS 1188.
2. The plants growing on rocky outcrops are inedible and considered kangaroo food only.
   ? (Mudburra/Ngarinyman) Bulla NMS 1080.

Cycas angulata R. Br. Cycadaceae

1. The ripe fruits are soaked in running water for 2-3 days to remove toxins, they are then suitable to be ground into flour to make damper.
   ? (Kunwinjku) Maningrida GMW 2226 & NMS.

Cycas armstrongii Miq. Cycadaceae

1. The fruits are edible after thorough preparation involving cooking, repeatedly crushing and leaching of toxins in fresh running water, this makes a thick paste which can be made into a tasty bread or damper.
   Tjuntju (Batjamal), **Marra** (Emi) Belyuen NMS 1053; **Warraga**=plant, **Läḻuk**=seeds (Djambarrpuyngu) Milingimbi GMW 4381 & NMS.
2. The ripe seeds can be split in two and the pieces chewed to make them into a soft paste, which is spat out onto a large leaf and roasted in hot ashes to make a damper. The green or partially ripe seeds must be soaked in running water for 2 - 3 days before being used.
   ? (Ngankikurungkurr) Nauiyu Nambiyu.

Cymbidium canaliculatum R. Br. Orchidaceae

1. The sap from the pseudobulbs is squeezed out directly onto sores of the skin to help them heal over and to provide relief from itchy skin.
2. The sap is also used to adhere ochres to bark or in 'olden times' to rock surfaces, to woomera's, spears or any other artefact for decorative purposes.
   Tjalamarinj (Ngankikurungkurr) Nauiyu Nambiyu NMS 465, NMS 623, NMS 1004.

Cymbopogon bombycinus (R. Br.) Domin Poaceae

1. Stems and leaves are chopped and boiled in a little water. The green liquid is used as a medicinal body wash to relieve the symptoms of colds, influenza, fever and headaches. A little of the mixture may also be sipped. The vapours inhaled whilst boiling will help clear the nose and chest.
   Wurringurlin (Mudburra) Elliott NMS 969; **Iyandinya** (Yanyula) Borroloola NMS 1259.
2. A little kino or red gummy exudate from *Eucalyptus terminalis* can be added to make the above treatment more effective. One old man said the liquid could be strained and then used as eye drops to relieve tired and sore eyes.
   Kurukuruny (Ngarinyman) Bulla NMS 761, NMS 1132.
3. The leaves and young stems are collected fresh, soaked in water overnight, covered with crushed termitaria(outer casing of termite mounds) and placed in a pit over hot coals. A pregnant mother giving birth lies over the pit for pain relief. Some of the heated mixture can be applied directly over hurting parts for pain relief. The newborn baby can be placed over the pit with the mother to make it quiet and placid. This is an important ritual in the management of infants that is still commonly practised today.
   Djirr (Dalabon/Jawony) Barunga NMS 354, NMS 557.

Cymbopogon obtectus S.T. Blake · Poaceae

1. A handful of finely chopped leaves, stems and flowers are boiled in half a billy can of water. The liquid is drunk to provide relief from coughs and colds.
   Ilintji (Pitjantjatjara) Tjunnanta NMS 616.

Cymbopogon procerus (R. Br.)Domin Poaceae

1. A good handful of leaves and a few stems are chopped, crushed, then soaked in water, (nowadays boiling of the water is more common). The liquid is used as a medicinal body wash for relief from colds, influenza and fevers.
   Gawulurr, Gawulurrani (Djambarrpuyngu) Galiwinku NMS 594; **?** (Ngarinyman) Bulla NMS 1076.
2. The leaves and stems are chopped and boiled in water and the liquid drunk as a cure for colds.
   ? (Kunwinjku) Jabiru NMS 1453.
3. Leaves softened by boiling or soaking can be inserted and left in the nasal cavity for relief from sinus trouble.
   Gawulurr, Gawulurrani (Djambarrpuyngu) Galiwinku NMS 594.
4. The whole plant is boiled in water and left for 2-3 days. The liquid can then be used as a medicinal wash to treat sores and cuts. A commonly used medicine and people have more faith in this preparation than those available at the health clinic such as 'Savlon'.
   Wurrunjinbung (Iwaidja) Minjilang NMS 154 & GMW.
5. The leaves and stems are pounded and soaked in water to produce a strong medicinal body wash; considered to be an especially strong treatment for headaches.
   Bu (Batjamal), **Kunbern** (Emi) Belyuen NMS 828 & GMW.
6. The culms (stems) make excellent childrens spears.
   ? (Ngarinyman) Bulla NMS 1076.

Cymbopogon refractus (R. Br.)A. Camus Poaceae

1. The leaves and stems are crushed and soaked in water. The mixture is rubbed vigorously over the body to relieve diarrhoea.
   Gabulurr (Djambarrpuyngu) Milingimbi GMW 3473 & NMS, GMW 4345 & NMS.

Cynanchum pedunculatum R. Br. Asclepiadaceae

1. The young fruits are eaten after roasting on hot coals.
   Midamurri (Ngankikurungkurr) Nauiyu Nambiyu NMS 1157.

Cyperus bulbosus Vahl Cyperaceae

1. The bulbs (corms) are roasted on hot coals, then rubbed between the palms of the hand to dehusk before eating.
   ? (Batjamal/Emi) Belyuen NMS 1064; **Tjanmata, Yarlga** (Pitjantjatjara/Yankunytjatjara) Apatula NMS 1189.

Cyperus javanicus Houtt. Cyperaceae

1. The angular flowering stems are used to weave very strong fishing nets , fish traps and dilly bags.
   Mewana (Djambarrpuyngu) Milingimbi GMW 3443 & NMS; **Su** (Ngankikurungkurr) Nauiyu Nambiyu NMS 446.

Cyperus victoriensis C.B. Clarke Cyperaceae

1. The corms are smashed and rubbed over the body or soaked in water and the liquid used as a body wash for relief from bad internal pain.
2. The plant is considered a good indicator that water can be found close by, either in shallow water holes or by digging down in the sand.
Puta puta (Pitjantjatjara/Yankunytjatjara) Apatula NMS 1206.

Dendrobium affine Steudel Orchidaceae

1. The sap from the pseudobulbs is squeezed directly onto sores and to relieve itchy skin.
Marndaja (Burarra/Djinang) Maningrida NMS 639 & GMW; **Tjalamarinj** (Ngankikurungkurr) Nauiyu Nambiyu NMS 464.
2. The sap from the pseudobulbs are rubbed onto the breasts of young girls at the time of the first menstruation.
Marndaja (Burarra/Djinang) Maningrida NMS 639 & GMW.
3. The sap from the pseudobulbs is used as an adhesive to glue ochres to rocks, artefacts, woomera's, spears and bark paintings. They can be chewed to soften them a little to produce a little more adhesive.
Marndaja (Burarra/Djinang) Maningrida NMS 639 & GMW; **Djalkurrk** (Djambarrpuyngu) Galiwinku NMS 598; **Djalkurrk, Dhonda** (Djambarrpuyngu) Milingimbi NMS 505 & GMW; **Tjalamarinj** (Ngankikurungkurr) Nauiyu Nambiyu NMS 464; **Djalkurrk** (Yolngu Matha) Yirrkala NMS 768.

Dendrobium canaliculatum R. Br. Orchidaceae

1. The pseudobulbs are squeezed and the sap is applied directly onto sores to help heal them.
2. The sap can also be squeezed directly onto the breasts of of young girls at the time of the first menstruation. This is done in conjunction with food restrictions.
3. The sap is used as an adhesive to adhere ochres to bark paintings.
Marndaja (Burarra/Djinang) Maningrida GMW 3863 & NMS.

Dicrostachys spicata (F. Muell.) Domin Mimosaceae

1. The spines of this species are inserted into the base of a wart to make it 'fall off'.
Kiyilmi (Jingulu) Elliott.

Dioscorea bulbifera L. Dioscoreaceae

1. The tuber is edible after it has been washed, cut, soaked in running water overnight and then roasted.
? (Malak-Malak) Wooliana NMS 439;
2. The tuber is edible after it has been cooked overnight in the hot ashes of wood from *Acacia auriculiformis*.
Wila (Batjamal), **Mithene** (Emi) Belyuen.

Dioscorea transversa R. Br. Dioscoreaceae

1. The elongate tuber is edible after roasting on hot ashes. It is then rubbed between the palms of the hand to remove any ash and dirt. It can also be boiled in water.
Mun-banda (Burarra) Maningrida GMW 3850 & NMS; **Wungmarratj**=yam, **Tjinbitj**=fertile parts, **Kangunmang**=sterile parts (Batjamal) Belyuen; **Murrumurru**=yam, **Tjinbitj**=fertile parts, **Kangunmang**=sterile parts (Emi) Belyuen; **Gulaka** (Djambarrpuyngu) Milingimbi GMW 3346 & NMS.

Diospyros maritima Blume Ebenaceae

1. The fruits are placed on hot ashes to soften them. They are then smashed with a little water and made into a paste which is applied sparingly with a stick to ringworm. Caution must be used as the paste is toxic and will burn the skin. The fruits are considered to be poisonous.
   Gulumunyu (Djambarrpuyngu) Galiwinku NMS 174.

Dodonaea physocarpa F. Muell. Sapindaceae

1. The branches and leaves can be boiled in water and the liquid used as a medicinal wash to relieve colds and influenza.
   ? (Ngarinyman) Bulla NMS 1090.

Dodonaea polyzyga F. Muell. Sapindaceae

1. The very sticky viscid foliage of this species is boiled in water and the liquid used as a medicinal body wash for relief from influenza.
   ? (Ngarinyman) Bulla NMS 1078.

Dolichandrone heterophylla (R. Br.) F. Muell. Bignoniaceae

1. The bark is boiled in water and the liquid is washed all over the body as an antiseptic treatment for sores of the skin and for relief from sore ears.
2. The wood makes excellent boomerangs.
   Larwa (Ngarinyman) Bulla NMS 1096.

Drypetes lasiogyna (F. Muell.) Pax & O. Hoffm. Euphorbiaceae

1. The fruits are eaten raw when ripe (red); sweet tasting.
   Yimungkawawurdarra (Anindilyakwa) Angurugu.

Duboisia hopwoodii (F. Muell.) F. Muell. Solanaceae

1. The leaves are smashed and thrown into a waterhole to stupify game such as emu. The branchlets are tested for potency by bending; if they bend over they are weak, if they snap they are considered strong enough to use as the drug. This species is not chewed as a stimulant in this area. *Nicotiana* spp. are preferred. One old man killed over 100 head of cattle in a water hole using this plant as a payback to a pastoralist who killed his best hunting dog. A detailed account on the use of this species has been given by Watson (1983).
   Walkal (Yankunytjatjara) Ulpulla NMS 1362.

Ehretia saligna R. Br. Boraginaceae

1. The wood of this species is very strong and it makes excellent boomerangs and nulla-nullas.
   Warlakarri (Ngarinyman) Bulla NMS 923.

Enchylaena tomentosa R. Br. Chenopodiaceae

1. The fruit is eaten raw when ripe (red/orange), although it is not highly prized.
2. Kangaroos eat the fruit.
   Mulili (Pitjantjatjara) Apatula NMS 1181; **Mulili** (Yankunytjatjara) Ulpulla NMS 1360.

Eragrostis eriopoda Benth. Poaceae

1. The seeds are winnowed from the heads and are ground on stones to make flour. This is mixed with water and made into small cakes or a type of damper which is then cooked on hot coals.
   Wangun (Yankunytjatjara) Apatula NMS 1166.

Eragrostis laniflora Benth. Poaceae

1. The seeds are winnowed from the heads and are ground to make a flour. This is mixed with a little water and is made into cakes or damper which is cooked on hot coals. At Ulpulla there is a large ceremonial ground surrounded by many grinding hollows carved into the rock surfaces. People would come from many miles away and this species would be the staple diet whilst the ceremonies were going on.
   Wangun (Yankunytjatjara) Ulpulla NMS 1371.

Eremophila alternifolia R. Br. Myoporaceae

1. The leaves can be finely chopped and boiled in water. The liquid can be drunk to provide relief from colds, influenza, coughs and headaches. It is also considered to be effective against any sickness of unknown cause. Considered to be one of the strongest medicines available.
   Irmangka-irmankga (Pitjantjatjara) Kaltukatjara NMS 611; **Irmangka-irmankga** (Pitjantjatjara) Tjunnanta NMS 617; **Irmangka-irmankga** (Pitjantjatjara) Wankari NMS 625.

Eremophila bignoniiflora (Benth.) F. Muell. Myoporaceae

1. A good handful of leaves are boiled in one half a flour tin of water. The liquid is used as a medicinal wash for the treatment of colds, influenza, fever and headaches. The boiled leaves and branches can be tied around the head to help relieve headaches associated with influenza. The mixture is too strong for use on babies.
   Kurumbimi (Jingulu/Mudburra) Elliott NMS 690.

Eremophila duttonii F. Muell. Myoporaceae

1. Fresh leaves are boiled in water and the liquid is used as a medicinal wash for the treatment of sores and cuts, for relief from colds and influenza and as a wash for sore eyes and ears. The Aranda name means kangaroo rolling, as the kangaroos knock down the branches and roll in them to help repel insects.
   Agherre intenhe (Eastern Aranda) Ltyentye Purte NMS 311.

Eremophila freelingii F. Muell. Myoporaceae

1. Fresh leaves are boiled in water and the liquid used as a body wash or bath to relieve colds, influenza and coughs. A little can also be applied as an antiseptic wash for open cuts and sores, and as an effective scabicide.
   Arrethe (Eastern Aranda) Ltyente Purte NMS 314.

Eremophila latrobei F.Muell. var. *glabra* L.S. Smith Myoporaceae

1. A handful of fresh leaves are boiled in a little water and the liquid drunk for relief from coughs and colds.
2. The flowers are sucked for their sweet nectar.
   Ngarankura (Pitjantjatjara) Wankari NMS 612.

Eremophila latrobei F. Muell. var. *latrobei* Myoporaceae

1. Fresh leaves are crushed and rubbed over the body or they can be crushed and soaked in water and the liquid used as a medicinal wash to help relieve the symptoms of colds and influenza. It is also good for any internal sickness, especially if you have been sick for a long time from an unknown cause.
2. The flowers are sucked for their sweet nectar.
   Minjinkta (Pitjantjatjara) Apatula NMS 1174.

Eremophila longifolia (R. Br.) F. Muell. Myoporaceae

1. Fresh leaves are smashed in a little water(nowadays boiling in water is often carried out) and then rubbed on the skin as a medicinal wash to treat scabies.
   Ortherrenge (Eastern Aranda) Ltyente Purte NMS 312; **Tulypur** (Yankunytjatjara) Ulpulla NMS 1354.
2. The leaves are used to flavour emu fat when cooking in bush earthen ovens. The whole skin is peeled off the emu, then stuffed full of leaves and roasted. This imparts an excellent taste to the skin and surrounding layers of fat.
3. Emu love to eat the fruit.
   Tulypur (Yankunytjatjara) Ulpulla NMS 1354.

Eremophila sturtii R. Br. Myoporaceae

1. Fresh leaves are boiled in water and the liquid is used as an antiseptic wash for sores and cuts, and as an all over body wash for relief from the symptoms of colds and influenza. The vapours given off when boiling can be inhaled to relieve a head cold and they will also help relieve sore eyes.
   Lporta lporta (Eastern Aranda) Ltyente Purte NMS 315.

Eriachne triseta Nees Poaceae

1. No use given.
   Mawurumi (Jingulu); **Yuka** (Mudburra) Elliott.

Eriosema chinense Vogel Fabaceae

1. The rounded tuber is eaten raw or after it has been roasted on hot ashes. The outer skin is often peeled off before eating. Commonly called the bush carrot because it has a similar taste to a carrot.
   Rungi (Djambarrpuyngu) Milingimbi GMW 3405 & NMS; **Mi-keoni** (Murrinh-Patha) Wadeye NMS 476; **Mukumalak** (Ngankikurungkurr) Nauiyu Nambiyu NMS 1007, NMS 1020.

Erythrophleum chlorostachys (F. Muell.)Baillon Caesalpiniaceae

1. The red inner bark is boiled in water and the strained liquid is used as an antiseptic wash for sores, cuts and any other skin problems.
   Kartungkun (Iwaidja) Minjilang NMS 156 & GMW; ? (Gaalpu/Kunwinjku) Warruwi NMS 131 & GMW; **Mandubang** (Kunwinjku) Jabiru NMS 1457; **Murutilla** (Dalabon) Gulin Gulin NMS 236.
2. The inner root bark is scraped out onto a fire and allowed to smoke. A breastfeeding mother will sit next to the fire allowing the smoke to flow all around her while inhaling some as well. This will dry up the breast milk.
   Maypiny (Djambarrpuyngu) Galiwinku NMS 170.
3. The wood is very hard and is used to make music or knocking sticks.
   Melhe (Batjamal), **Mawuny** (Emi) Belyuen NMS 844.

4. The wood is strong and is used for many purposes, mainly for fencing posts and building houses.
   Mandubang (Kunwinjku) Jabiru NMS 1457.
5. The old dry wood can be used for cooking on a fire but never the young or fresh wood as it is considered poisonous.
   Mawunj (Ngankikurungkurr) Nauiyu Nambiyu NMS 451.
6. The wood from this species is very hard, no use recorded.
   Marndarn-ngara (Jingulu) Elliott NMS 1005.
7. The leaves are burnt and used in smoking ceremonies after the death of a person to clean up areas, i.e. to cleanse houses or camp sites of spirits.
   Maypiny (Djambarrpuyngu) Galiwinku NMS 170; ? (Gaalpu/Kunwinjku) Warruwi NMS 131 & GMW; **Kartungkun** (Iwaidja) Minjilang NMS 156 & GMW; **Mawunj** (Ngankikurungkurr) Nauiyu Nambiyu NMS 451.
8. The leaves and branches can be heated and placed directly over areas of pain by a faith healer. Any sort of ache or pain can be treated and a lot of trust is put in the ability of the faith healer.
   Mawunj (Ngankikurungkurr) Nauiyu Nambiyu NMS 451.
9. The leaves can be boiled in water and the liquid used as a medicinal wash for sores of the skin. Not a commonly used medicine today.
   ? (Gaalpu/Kunwinjku) Warruwi NMS 131 & GMW.

Erythroxylum ellipticum R. Br. Erythroxylaceae

1. The fruits are eaten raw when ripe (red).
   Burlburl (Dalabon), **Beleman** (Jawony) Barunga NMS 331.
2. The clear gummy exudate from the branchlets of this species is eaten raw as a sweet.
   Marlaliny (Ngarinyman) Bulla NMS 922.

Eucalyptus bleeseri Blakely Myrtaceae

1. The red gummy exudate (kino) from this species is applied directly onto sores and cuts to help them heal. If crystalline, the gum can be boiled with a little water and applied as liquid.
2. Freshly cut tribal and decorative scars across the chest and arms are rubbed with a mixture of the gum and ash to accentuate the scarring. A few large black ants are then placed on the cuts to clean up any exposed flesh. The ants are called **Borlulurrum** by the Rembarrnga.
   Jior= gum (Rembarrnga) Maningrida NMS 661 & GMW.

Eucalyptus camaldulensis Dehnh. Myrtaceae

1. The bark is burnt to a fine ash and is used as an additive when chewing tobacco.
   Itara (Pitjantjatjara) Apatula NMS 1187; **Timalarn** (Ngarinyman) Bulla NMS 910.
2. The bark can be boiled in water and the liquid used as a medicinal wash for relief from colds and influenza. A little of the liquid can also be sipped to cure a sore throat.
   Garlabirr (Yanyula) Borroloola NMS 1233.
3. Fresh leaves are boiled in water and the liquid is used as a body wash for relief from colds and influenza. A little of the liquid can also be drunk.
   Timalarn (Ngarinyman) Aminbidji NMS 1140; **Timalarn** (Ngarinyman) Bulla NMS 759, NMS 910; **Garlabirr** (Yanyula) Borrolola NMS 1233.
4. Fresh leaves are boiled in water and the liquid is used as a warm body wash for relief from internal pain. It works especially well for relieving aches and pains in the joints, especially hips, knees, ankles etc., and for chest pain. The pain may be associated with influenza, fever or rheumatism.
   Bilinga (Jingulu/Mudburra) Elliott NMS 702.

5. Fresh young leaves are used medicinally to treat general sickness, fever, colds and influenza by placing them in a pit over hot coals. The smoke arising is allowed to flow all around the sick patient who also inhales some. This is considered to be a very effective treatment that is still commonly used today in favour of western medicines.
6. The leaves are used as food flavouring especially when cooking game in bush earthern ovens.
7. This species is one of the favoured hosts for the native bee nests, of which the honey and pollen stored by the bees has both nutritional and medicinal value as a cure for diarrhoea.

   Timalarn (Ngarinyman) Bulla NMS 759, NMS 910.

Eucalyptus clavigera Cunn. ex Schauer Myrtaceae

1. The bark is burnt to a fine ash and is mixed with commercially available chewing tobacco (*Nicotiana tabacum*). The addition of ash frees the nicotine to potentiate the tobacco (Watson 1983).

   Yalan (Murrinh-Patha) Wadeye.

Eucalyptus confertiflora F. Muell. Myrtaceae

1. The bark is burnt to a fine ash and is added to chewing tobacco (*Nicotiana tabacum*). The addition of ash frees the nicotine to potentiate the tobacco (Watson 1983).
2. The burnt bark is added to natural dyes to produce darker colours i.e. yellow to brown or pink to maroon.

   Djambattba (Batjamal), **Arra** (Emi) Belyuen NMS 867.

Eucalyptus dichromophloia F. Muell. Myrtaceae

1. In the past leaves were boiled in water and the liquid was used as a body wash for relief from colds and influenza. Not a very commonly used medicine today.

   Jardburru (Jingulu) Elliott NMS 993.

Eucalyptus microtheca F. Muell. Myrtaceae

1. The bark is burnt to a fine ash and is added to chewing tobacco (*Nicotiana tabacum*) and pituri (*Duboisia hopwoodii*). The addition of ash frees the nicotine to make the tobacco more powerful (Watson 1983).
2. The inner bark is chopped and boiled in water and the liquid used as a body wash for relief from colds and influenza.
3. Fresh young leaves are boiled in water and the liquid is used as an all over body wash for relief from colds, influenza and any internal pains such as pain in the joints i.e. hips and knees. A little of the liquid can also be sipped to help relieve a head cold.
4. Insect galls found on this species are eaten raw. They are a highly prized food.

   Bidbirdarra (Jingulu/Mudburra) Elliott NMS 691.
5. This species is the favoured host to the native bee nest; the pollen stored by the bees and honey has both nutritional and medicinal value as a cure for diarrhoea.

   Kirningi (Ngarinyman) Bulla NMS 930.

Eucalyptus miniata Cunn. ex Schauer Myrtaceae

1. The inner bark is chopped and boiled in water and the liquid is used as a wash for relief from coughs, colds, influenza and chest infections. A little of the liquid can also be sipped.

   Timirraringa (Tiwi) Paru.

2. The inner bark can be chopped and boiled in water and the liquid used as an antiseptic wash for sores and cuts and to treat other skin conditions such as scabies.
   Timirraringa (Tiwi) Pularumpi NMS 1266.
3. Considerd to be a good shady tree.
4. Black cockatoos eat the seeds from this species.
   Karrbek (Batjamal) Belyuen. **Gungurru** (Djambarrpuyngu) Milingimbi.

Eucalyptus opaca D. Carr & S. Carr Myrtaceae

1. The red gummy exudate from this species is applied directly onto open cuts, sores and scabies as a very effective healing agent. A commonly used medicine today.
2. A little of the gum can be boiled in water and the liquid splashed around the eyes to relieve soreness.
3. The galls off this species are eaten raw; locally called the "bush apple".
   Arrkenke (Eastern Aranda) Ltyentye Purte NMS 317.

Eucalyptus papuana F. Muell. Myrtaceae

1. The timber is hard and durable making excellent building materials.
   ? (Ngarinyman) Bulla NMS 947.
2. The bark is burnt to a fine ash and soaked in water to produce a green dye which is commonly used to colour dilly bags .
   Dharpa (=trees) (Djambarrpuyngu) Milingimbi GMW 4315 & NMS.
3. Considered a good shady tree.
   Denwiny (Batjamal), **Arra** (Emi) Belyuen.

Eucalyptus pruinosa Schauer Myrtaceae

1. The inner bark is chopped and boiled in water. The liquid is sipped whilst still warm for relief from colds, influenza, fever and for general sickness. It is also good for general pains in the muscles; if you are weak with influenza it will get you walking again.
   Janypiny (Ngarinyman) Aminbidji NMS 1118; **Janypiny** (Ngarinyman) Bulla NMS 730, NMS 920, NMS 953.

Eucalyptus tectifica F. Muell. Myrtaceae

1. This species is host to the best termites producing termitaria (termite mounds) that can be eaten as a medicine for relief from stomach upsets, abdominal pain and period pain. People seek out this tree and then look for the infestations of the termites.
   Yeden (Ngangkikurungkurr) Nauiyu Nambiyu NMS 453.

Eucalyptus terminalis F. Muell. Myrtaceae

1. The seeds are used as childrens toys; when thrown into the air they spiral down like a helicopter.
2. The red gummy exudate from this species is applied directly onto sores and cuts or it can be boiled with a little water and applied as an antiseptic wash.
3. A little of the gummy exudate boiled in water can be sipped for relief from bad coughs and headaches. Some of the mixture can also be used in conjunction with *Cymbopogon bombycinus* to treat colds and influenza.
   Narrka=tree, **Manyuwan**=gum, **Jirtpirtpi**=seeds (Ngarinyman) Aminbidji NMS 1135; **Narrka**=tree, **Manyuwan**=gum, **Jirtpirtpi**=seeds (Ngarinyman) Bulla NMS 738.

Eucalyptus tetrodonta F. Muell. Myrtaceae

1. The inner bark is pounded and boiled in water. The purple liquid produced is used as a wash as an effective scabicide.
   Walurru (Iwaidja) Minjilang NMS 152 & GMW.
2. The inner bark is chopped and infused in water to produce a mouth wash for sores and for red inflamed tongues.
   Gadayka=tree, **Dhanay**=bark, (Djambarrpuyngu) Milingimbi NMS 1067 & GMW.
3. The inner bark is boiled in water and the purple liquid drunk for relief from colds and headaches.
   Ngumala (Burarra) Maningrida NMS 515.
4. The bark is used extensively as a medium on which bark paintings are made.
   Barndala (Batjamal), **Wuyi** (Emi) Belyuen GMW 4524 & NMS; **Ngumala** (Burarra) Maningrida NMS 515 ; **Gadayka**=tree, **Dhanay**=bark (Djambarrpuyngu) Galiwinku NMS 166; **Gadayka**=tree, **Dhanay**=bark (Djambarrpuyngu) Milingimbi NMS 1067 & GMW; ? (Kunwinjku) Jabiru NMS 1459; **Gadayka** (Yolngu Matha) Yirrkala NMS 179.
5. Young fresh leaves are infused or boiled in water to produce a purple liquid which is drunk to help clear up colds, influenza, headaches, chest colds, bronchitis, coughs and to remove any phlegm from the throat.
   Gadayka=tree, **Dhanay**=bark (Djambarrpuyngu) Galiwinku NMS 166.
6. Young fresh leaves can be crushed directly onto sores and cuts or the leaves boiled in water to produce a purple liquid which is used as an antiseptic wash for sores and cuts.
   ? (Gaalpu/Kunwinjku) Warruwi NMS 130 & GMW; **Walurru** (Iwaidja) Minjilang NMS 152 & GMW; **Gadayka** (Yolngu Matha) Yirrkala NMS 179.
7. The leaves are chewed to help relieve sore throats.
   ? (Gaalpu/Kunwinjku) Warruwi NMS 130 & GMW.
8. The leaves are used to flavour buffalo meat when cooking in bush earthern ovens.
   Ngumala (Burarra) Maningrida NMS 515.

Eulalia aurea (Bory) Kunth Poaceae

1. The whole plant is crushed and chopped on a coolamon using an axe. It is then layered in the coolamon with crushed termitaria(termite mounds). The coolamon is placed over a bed of hot coals and heated. A mother and her newborn baby sit very close allowing the steam and smoke to engulf them. This treatment ensures the mother and baby will be healthy and not suffer any ill effects from the trauma of the birth. Once heated the mixture can be pounded with the axe and the liquid collected and rubbed over the breasts of the mother to bring the milk down. A little of the liquid is also fed to the baby to treat thrush of the mouth.
   Liyiji (Jingulu/Mudburra) Elliott NMS 695, NMS 972.

Euphorbia hirta L. Euphorbiaceae

1. The white sap or milky latex from this species is applied directly onto small skin sores to help heal and protect them from dirt.
   Warlakarri (Ngarinyman) Bulla NMS 767, NMS 945.

Euphorbia tannensis Sprengel Euphorbiaceae

1. The whole plant is heated on a fire till soft when it is rubbed over the skin or alternatively the latex can be squeezed out and boiled in water and the liquid used as a medicinal wash; both methods are very effective against scabies.
   Ipi-Ipi (Pitjantjatjara) Apatula NMS 1170.

Excoecaria ovalis Endl. Euphorbiaceae

1. This plant is considered to be toxic as any contact with the latex will cause the skin to swell and blister.
   Ngarrawu (Djambarrpuyngu) Milingimbi GMW 703.

Excoecaria parvifolia Muell. Arg. Euphorbiaceae

1. The red inner bark and the milky latex are boiled in water and the liquid is used as a medicinal wash to treat chicken pox, scabies and as an antiseptic wash for sores and cuts. It can also be used as a rub to reduce swellings i.e. those as a result from impact with a boomerang, and to relieve any internal pain such as pain in the stomach, chest or acheing muscles. Do not get this liquid or the latex into the eyes as it will cause blindness.
2. The wood makes excellent boomerangs.
   Mulagja (Jingulu) Elliott NMS 692; **Manyingila** (Mudburra) Elliott NMS 973; **Manyingila** (Ngarinyman) Bulla NMS 764, NMS 928.

Exocarpos latifolius R. Br. Santalaceae

1. The inner bark is boiled in water and the liquid used as a wash to relieve colds and influenza. A little of the liquid can also be sipped.
   Narlij (Ngarinyman) Bulla NMS 1077.
2. Fresh leaves and branches are placed over a pit of hot coals and allowed to smoke. A newborn baby is held close in the mothers arms and is rocked back and forward over the rising smoke. This treatment is an important ritual in the management of infants as it makes sure the child will grow up healthy and strong.
3. The fruits are edible when ripe (red).
   Nulkngawakbunbun (Batjamal), **Thidirr** (Emi) Belyuen NMS 909, NMS 1047.

Ficus coronulata Miq. Moraceae

1. The milky latex exuding from broken twigs or leaves is dabbed directly onto sores and cuts to help them heal over and to protect them from dirt. It can also be applied directly onto boils to help draw them out.
2. Fresh leaves and branches can be boiled in water and the liquid applied as an antiseptic wash to treat sores of the skin.
3. The fruits are eaten raw when ripe (soft).
4. Turtles get fat eating the ripe fruit when they fall into the water. Therefore fruiting time indicates it is a good time to hunt for turtle.
   Japawing (Ngarinyman) Bulla NMS 913, NMS 1133.

Ficus opposita Miq. Moraceae

1. The inner bark is scraped into water and boiled. The liquid is drunk to treat diarrhoea and is used as an antiseptic wash for sores.
   Muthir' (Djambarrpuyngu) Galiwinku NMS 161; **Muthi** (Yolngu Matha) Yirrkala NMS 178.
2. The rough leaves are used to abrade the surface of ringworm and fungal infections before the application of *Passiflora foetida.*
   Midjinymidjiny (Batjamal), **Nyimara** (Emi) Belyuen NMS 871, NMS 1062, NMS 1415, GMW 4525.
3. The rough sandpapery leaves are used as sandpaper to smooth down artefacts and spears.
   Warrwi (Ngarinyman) Bulla NMS 907.

4. The fruit is eaten raw when ripe (black); considered good tucker.
Midjinymidjiny (Batjamal), **Nyimara** (Emi) Belyuen NMS 871, NMS 1062, NMS 1415, GMW 4525; **Muthir'** (Djambarrpuyngu) Milingimbi GMW 3332 & NMS; **Warrwi** (Ngarinyman) Bulla NMS 907; **Muthi** (Yolngu Matha) Yirrkala NMS 178.

Ficus platypoda (Miq.) Miq. Moraceae

1. The fruit is eaten raw when ripe (red); considered very sweet.
? (Gaalpu/Kunwinjku) Warruwi GMW 3155 & NMS.

Ficus platypoda (Miq.) Miq. var. ***lachnocaula*** (Miq.) Benth. Moraceae

1. The fruits are eaten raw when ripe (red); considered sweet and can be collected from the ground.
Jaramulu (Ngarinyman) Bulla NMS 754.

Ficus platypoda (Miq.) Miq. var. ***minor*** Benth. Moraceae

1. The fruit are eaten raw when ripe (red), or the old dry fruits can be collected from the ground, ground into flour and made into a paste and eaten or rolled into balls and eaten at a later date.
? (Eastern Aranda) Ltyentye Purte NMS 318; **Ili** (Pitjantjatjara/Yankunytjatjara) Ulpulla NMS 1364.
2. A paste made from the old dry fruits which have been ground into a flour and mixed with water is eaten as a cure for stomache ache and diarrhoea.
Ili (Pitjantjatjara/Yankunytjatjara) Ulpulla NMS 1364.

Ficus platypoda (Miq.) Miq. var. ***platypoda*** Moraceae

1. The fruit is eaten raw when ripe (red), often they are collected from the ground.
Jaramulu (Ngarinyman) Bulla NMS 756; **Tinpali** (Ngarinyman) Bulla NMS 752.

Ficus racemosa L. Moraceae

1. The fruit is eaten raw when ripe (red); considered to be very sweet.
Jatkala (Ngarinyman) Aminbidji NMS 1142; **Jatkala** (Ngarinyman) Bulla NMS 1134.

Ficus scobina Benth. Moraceae

1. The rough leaves are used to sandpaper artefacts and weapons.
? (Jawony) Katherine.
2. The fruit is eaten raw when ripe (black).
? (Jawony) Katherine; ? (Malak-Malak) Wooliana NMS 432, NMS 443; ? (Tiwi) Pularumpi NMS 1011.

Ficus virens Aiton Moraceae

1. The aerial roots are used to manufacture dilly bags and fishing lines.
? (Malak-Malak) Wooliana.
2. The fruit is eaten raw when ripe (white).
Wuny (Batjamal/Emi) Belyuen; **Warnwarn** (Dalabon/Jawony) Barunga NMS 349.

Fimbristylis sp. Cyperaceae

1. No use recorded.
Melgin (Emi) Belyuen NMS 829.

Flacourtia territorialis Airy Shaw — Flacourtiaceae

1. The fruit is eaten raw when ripe (red).
   ? (Iwaidja) Minjilang GMW 3255 & NMS.

Flagellaria indica L. — Flagellariaceae

1. The stems are stripped and plaited to make arm bands and bracelets for decoration, especially during ceremonies.
   Tjelerre (Batjamal/Emi) Belyuen NMS 816; **Guwatjura** (Djambarrpuyngu) Milingimbi GMW 3345 & NMS; **?** (Yolngu Matha) Yirrkala.
2. A short section of stem (10 - 12" long) is chopped and boiled in water and the liquid is used as a wash for relief from colds, stomach ache and diarrhoea.
   Mowkatai (Tiwi) Paru NMS 561 & GMW.

Flueggea virosa (Roxb. ex Willd.)Voigt — Euphorbiaceae
ssp. *melanthesoides* (F.Muell.)Webster

1. The ripe fruits are boiled in water and the liquid is used as a wash for relief from various skin conditions such as itchy skin. The mixture is only used once.
   Kudjung (Dalabon/Jawony) Barunga NMS 332.
2. The fruits are eaten raw when ripe (white).
   Wultja (Batjamal) Belyuen NMS 803; **Jirrki** (Burarra) Maningrida; **Räga** (Djambarrpuyngu) Milingimbi GMW 3336 & NMS; **Therrrerny** (Emi) Belyuen NMS 1026; **Ngaburrayimi** (Jingulu) Elliott; **Jurrulana** (Mudburra) Elliott GMW 5235 & L.L.V.Williams; ? (Malak Malak) Wooliana; **Mi-Kurak** (Murrinh-Patha) Wadeye; **Kumpulyu** (Ngarinyman) Bulla NMS 917, NMS 948; **?** (Rembarrnga) Gulin Gulin.

Gardenia megasperma F. Muell. — Rubiaceae

1. A few square inches of bark is boiled in water and the liquid is used as a wash to treat skin disorders and itchy skin.
   Nang-Nang (Ngarinyman) Bulla NMS 1075.
2. The apical growing tip is broken off and the clear sticky sap is applied directly to sores of the skin to help them dry up and heal.
   Yedinin (Ngankikurungkurr) Nauiyu Nambiyu NMS 621, NMS 1006, NMS 1024.

Gardenia sp. — Rubiaceae

1. The bark is chopped and boiled in water. The liquid is used as a medicinal wash for the relief of skin conditions such as allergies, rashes and ringworm.
   ? (Yanyula) Borroloola NMS 1219, NMS 1254.

Gardenia sp. — Rubiaceae

1. The inner bark is boiled in water and the liquid is used as a wash to relieve itchy skin.
   Nang-Nang (Ngarinyman) Bulla NMS 749.

Gossypium australe F. Muell. — Malvaceae

1. This plant possibly has some medicinal use, however my informants were not sure. Possibly used as a medicine by the neighbouring Mudburra people.
   Pinampalij ? (Ngarinyman?) Bulla NMS 934.

**Gossypium hirsutum* L. Malvaceae

1. Cotton wool is obtained from the fruit that can be used for many purposes, similar to the commercially available cotton wool. This is not a native species, but the Aboriginal name given is the same as *Bombax ceiba* whose fruits also contain cottony fibres.
   Gulu' (Djambarrpuyngu) Milingimbi GMW 4403 & NMS.

Grevillea dimidiata F. Muell. Proteaceae

1. The caustic sap contained in the outer stems and particularly the follicles is used to burn the skin to produce scars for decoration. This species also has ceremonial significance.
   Warlubum ? (Gurindji) Kalkaringi; ? (Ngarinyman) Bulla NMS 729.

Grevillea heliosperma R. Br. Proteaceae

1. The bark is chopped and boiled in water. The liquid is used as a wash to treat skin conditions such as infected sores and scabies. This medicine is commonly used today.
   Yalyana (Yanyula) Borroloola NMS 1255.

Grevillea juncifolia Hook. Proteaceae

1. The flowers are sucked to remove the sweet nectar or a few flowers can be placed in a billy can to collect the draining nectar. Flowers can also be soaked in water to make a sweet refreshing drink.
   Ultukunpa (Pitjantjatjara/Yankunytjatjara) Apatulla NMS 1191.

Grevillea pteridifolia Knight Proteaceae

1. Fresh leaves are used to flavour meats especially emu. Leaves are placed on a bed of hot coals, the meat is placed on top and is completely covered with more leaves. The whole lot is covered with paperbark (*Melaleuca* spp.), topped with soil and allowed to cook for many hours.
2. Emu eat the flowers and seeds off this species to produce large fat eggs.
   Watbarr (Rembarrnga) Maningrida GMW 3896 & NMS.
3. The nectar is sucked from the flowers for its sweet taste.
   Mi murtak (Murrinha-Patha) Wadeye NMS 1348.

Grevillea striata R. Br. Proteaceae

1. Nectar is sucked from the flowers.
   Bukumara (Jingulu) Elliott.

Grewia multiflora A.L. Juss. Tiliaceae

1. The sweet fruits are eaten raw when ripe (black). It is considered by the older Malak-Malak people at Wooliana to be an European plant, introduced to the area and gone wild.
   ? (Malak-Malak) Wooliana NMS 438.

Grewia orientalis Benth. Tiliaceae

1. The inner bark from the base of the stems and roots is twisted then soaked in water (or more commonly today boiled in water). In 'old-times' hot stones would have been used to heat the liquid. The liquid is used as a medicinal wash to treat boils.
   Murrtjumun (Djambarrpuyngu) Galiwinku NMS 583.

2. The fruit is eaten raw when ripe.
? (Batjamal/Emi) Belyuen NMS 1416; **Murrtjumun** (Djambarrpuyngu) Galiwinku NMS 583.

Grewia retusifolia Kurz Tiliaceae

1. The roots are cleaned to remove all dirt, then boiled in water or roasted on the fire to make them soft. The outer bark is scraped away and the root is placed in cold water for about five minutes. The liquid then takes on a jelly consistency being used as an antiseptic application for sores and to help draw out and heal boils.
Mutamuta (Djambarrpuyngu) Milingimbi GMW 3330 & NMS.
2. The roots are stripped of outer bark, heated on hot coals then placed directly as a poultice over boils to help draw them out.
Mutamuta (Djambarrpuyngu) Galiwinku NMS 162.
3. The roots and sometimes sections of stems are scraped, cleaned , crushed and soaked in water (more commonly today the mixture is boiled). The liquid is used as an antiseptic wash for skin conditions such as infected sores, cuts, boils and scabies.
Burdartuma (Burarra) Maningrida NMS 516, NMS 646 & GMW; **Mutamuta** (Djambarrpuyngu) Ramingining NMS 656 & GMW; **Kangarn** (Ngarinyman) Aminbidji NMS 1137; **Kangarn** (Ngarinyman) Bulla NMS 726, NMS 901, NMS 1103; **Murrtjumun** (Yolngu Matha) Yirrkala NMS 213.
4. A few roots are cleaned, smashed and boiled in water. The liquid is used as an eye wash for sore, infected and tired eyes.
Marwurrangyi (Yanyula) Borroloola NMS 1261.
5. The root bark is crushed and boiled in water and the liquid is drunk to treat bad headaches or as 'a pick me up' if you are feeling really tired.
Djodmo (Dalabon), **Moyangka** (Jawony) Barunga NMS 343.
6. The root and sometimes a few pieces of stem are crushed and boiled in water. The liquid is drunk to treat diahorrea and to help bring down high temperatures associated with a fever.
Djodmo (Dalabon) Gulin Gulin NMS 237; **Kangarn** (Ngarinyman) Aminbidji NMS 1137; **Kangarn** (Ngarinyman) Bulla NMS 726, NMS 901, NMS 1103.
7. The root is crushed and the mucilage is used as a strong glue. In the past it has been used to adhere ochres to bark paintings and to hold feathers or leaves to the body during ceremonies.
Djodmo (Dalabon), **Moyangka** (Jawony) Barunga NMS 343.
8. A good handful of leaves and some stems can be boiled in water and the liquid drunk to relieve stomach upsets and diarrhoea.
Kangarn (Ngarinyman) Aminbidji NMS 1137; **Kangarn** (Ngarinyman) Bulla NMS 726, NMS 901, NMS 1103; **Maruwurrangyi** (Yanyula) Borroloola NMS 1261.
9. The fruits are eaten raw when ripe (brown). Children often spend long periods collecting and eating the fruits.
Mayawung (Batjamal) Belyuen NMS 850; **Burdartuma** (Burarra) Maningrida NMS 516, NMS 646; **Mutamuta** (Djambarrpuyngu) Galiwinku NMS 162; **Mutamuta** (Djambarrpuyngu) Milingimbi GMW 3330 & NMS; **Mutamuta** (Djambarrpuyngu) Ramingining NMS 656 & GMW; **Muman** (Emi) Belyven NMS 1027; ? (Murrinh-Patha) Wadeye NMS 484; **Kangarn** (Ngarinyman) Aminbidji NMS 1137; **Kangarn** (Ngarinyman) Bulla NMS 726, NMS 901, NMS 1103; **Marwurrangyi** (Yanyula) Borroloola NMS 1261.

Grewia sp. Tiliaceae

1. Spears are made from the straightest stems. The outer bark is peeled off, the stem heated over hot coals and then straightened by hand using the teeth or toes to hold it tight.

2. The small fruits are eaten raw when ripe (black).
Wirlirt (Ngarinyman) Bulla NMS 1079.

Grewia sp. (CRD 6477) Tiliaceae

1. The fruit is eaten raw when ripe.
Murrtjumun (Djambarrpunyngu) Milingimbi GMW ? & NMS.

Gyrocarpus americanus Jacq. Hernandiaceae

1. The trunk is used to make sea going canoes.
Dulumuru (Djambarrpuyngu) Milingimbi GMW 3447 & NMS.
2. The wood is used to manufacture coolamons and for carving artefacts.
Kulunjurru (Jingulu), **Yimbija** (Mudburra) Elliott NMS 991; **Kulinjiri** (Ngarinyman) Bulla NMS 760.
3. The inner bark is smashed and boiled in water and the liquid used as a wash to treat ringworm. The liquid is not to be drunk as it is poisonous.
Kulinjiri (Ngarinyman) Bulla NMS 1092.
4. The inner bark has been used in the past as a poison (possibly in the terms of the payback system or euthanasia).
Yimbija (Mudburra) Elliott NMS 991.
5. The seeds are used as childrens toys; they throw them into the air and watch them spiral down to the ground.
Kulunjurru (Jingulu), **Yimbija** (Mudburra) Elliott NMS 991; **Najan** (Iwaidja) Minjilang GMW 3256 & NMS; **Kurlinjura** (Ngarinyman) Bulla NMS 1092.

Haemodorum coccineum R. Br. Haemodoraceae

1. The orange/red tuberous rootstock is crushed and boiled in water to give an orange dye. Ash is added to darken the colour. Mostly used to dye strings and rope woven from *Pandanus*.
Berrungberrung (Batjamal/Emi) Belyuen NMS 792; **Wirndilk** (Kunwinjku) Jabiru NMS 1472 ; **Nanthi tek** (Murrinh-Patha) Wadeye.
2. The fruits are crushed and boiled in water to produce a red/pink dye. Used to dye string to make dilly bags and woven *Pandanus* leaf products. Can be mixed with ash to darken the colour.
Berrungberrung (Batjamal/Emi) Belyuen NMS 792; **Warlanykari** (Ngarinyman) Bulla NMS 742; ? (Jawony/Ngalkbun) Barunga NMS 543; ? (Ngankikurungkurr) Nauiyu Nambiyu NMS 425.

Haemodorum sp. Haemodoraceae

1. The tuberous rootstock is smashed and boiled in water to produce a red dye used to colour baskets woven from *Pandaus* leaves.
Wirdilwidil (Kunwinjku) Maningrida NMS 640.

Hakea arborescens R. Br. Proteaceae

1. The inner bark is boiled in water and the liquid used as a wash to treat scabies and itchy skin.
Dilyarra (Jingulu) Elliott NMS 723; ? (Ngarinyman) Bulla NMS 1089.

Hakea divaricata L. Johnson — Proteaceae

1. The pungent phyllodes are inserted around the base of warts to make them wither and fall off.
2. The nectar is sucked from the flowers by children or a lot of flowering spikes can be collected and placed in a tin to collect the draining nectar.
   Ontyiye (Eastern Aranda) Ltyentye Purte.

Hakea eyreana (S. Moore) McGillivray — Proteaceae

1. The burnt bark produces a fine ash which is applied directly onto weeping sores or ulcers that will not heal. Use as often as required to keep the sore dry.
2. The burnt ash is mixed with a little water to produce a black paint for decorating artefacts, shields and bodies during ceremonies.
3. The pungent leaves are inserted around the base of a wart to make it wither and fall off.
   Ontyiye (Eastern Aranda) Ltyentye Purte NMS 310.
4. The flowers are sucked by children for their nectar or many flowering spikes can be placed in a tin and the draining nectar collected.
   Ontyiye (Eastern Aranda) Ltyentye Purte NMS 310; **Witjinti** (Pitjantjatjara/Yankunytjatjara) Apatula.
5. This species has special ceremonial significance.
   Witjinti (Yankunytjatjara) Apatula.

Hakea macrocarpa Cunn. ex R. Br. — Proteaceae

1. The corky bark is burnt to produce a black powdery ash. The powder is applied to babies lips which are cracked and sore. It is also good for sores of the mouth.
   Bilyilungu, Marlu, Warrakyala (Jingulu) Elliott NMS 980.

Hakea suberea S. Moore — Proteaceae

1. The bark is burnt to a fine black powdery ash which is applied to sores in the mouth and as a treatment for thrush of the mouth.
2. The inner bark is smashed and boiled in water and the liquid used as a antiseptic wash for sores of the skin.
3. The flowers are sucked as a source of nectar.
   Marlu (Wambiya) Elliott NMS 988.

Halgania glabra J. Black — Boraginaceae

1. One old man said that the leaves and stems were boiled in water and the liquid used as a body wash for the treatment of colds and influenza. A little of the liquid could be sipped. However a group of ladies consulted said that this species definitely was not a medicine. This information needs further checking.
   Ilintji (Pitjantjatjara) Kaltukatjara NMS 615.

Hanguana malayana (Jack) Merrill — Hanguanaceae

1. This species has special ceremonial significance.
   Arlambirrarlambirr (Iwaidja) Minjilang GMW 3265 & NMS.

Helicteres elongata Wallich ex Bojer — Sterculiaceae

1. The tuberous rootstock is made into a strong string to make dilly bags.
   Kumuduk, Gupudu (Dalabon/Jawony) Barunga NMS 342.

Heteropogon triticeus (R. Br.) Stapf — Poaceae

1. The culms are chewed and sucked by children for their sweet taste.

2. The culms are chewed as a source of water especially when walking overland during the dry season.
   Murdaymbunga, Mu-golurra (Burarra) Maningrida NMS 538.
3. The stems are used by chilren as spears.
4. The spikelets are used as toys by children to spear flies that land on sores.
   Ritharr' (Djambarrpuyngu) Milingimbi GMW ? & NMS.

Hibiscus tiliaceus L. Malvaceae

1. The wood is used to manufacture artefacts. It carves very well.
   ? (Ngangkikurungkurr) Nauiyu Nambiyu NMS 1021; **Yäl** (Yolngu Matha) Yirrkala NMS 184.
2. The inner bark is twisted and crushed and the mucilage exuded placed directly on boils or alternatively the inner bark can be crushed and soaked in boiling water and the liquid used as wash to treat boils.
   Yäl (Djambarrpuyngu) Galiwinku NMS 584; **Yäl** (Yolngu Matha) Yirrkala NMS 184.
3. The inner bark is peeled and plied into a strong string or rope. Often it is used for tying up mudcrabs.
   Kabalalha (Batjamal), **Wunmerr** (Emi) Belyuen NMS 811, NMS 1037.
4. The leaves are used as plates to protect food from spoilage in the dirt.
   Yäl (Djambarrpuyngu) Galiwinku NMS 584.

Hypoxis nervosa R. Henderson Liliaceae

1. The corm is edible after roasting on hot ashes.
   Walungu, Djalpinyngu (Djambarrpuyngu) Milingimbi GMW 3409 & NMS.

**Hyptis suaveolens* (L.) Poit. Lamiaceae

1. Formerly the old people dried the leaves to use as a tobacco. They were smoked in old Macassar style pipes. This is not a native species hence no specific Aboriginal name was remembered.
   ? (Burarra) Maningrida NMS 530.
2. Children make spears from the stems.
   Djuktjuknganing (Djambarrpuyngu) Milingimbi GMW 4319 & NMS.

Ichnocarpus frutescens R. Br. Apocynaceae

1. The roots are, or have been in the past, used to make fish traps.
   ? (Malak-Malak) Wooliana NMS 441.

Ipomoea abrupta R. Br. Convolvulaceae

1. The tuber is edible after roasting on hot coals.
   Bäwang (Djambarrpuyngu) Milingimbi GMW 3507 & NMS.

Ipomoea graminea R. Br. Convolvulaceae

1. The tuber is eaten raw or after roasting on hot coals.
   Wardbirrja (Burarra) Maningrida GMW 5410; **Duynga, Organay** (Djambarrpuyngu) Galiwinku NMS 568; **Duynga, Organay** (Djambarrpuyngu) Milingimbi GMW 3328 & NMS.

Ipomoea pes-caprae (L.) Sweet ssp. ***brasiliensis*** (L.) Ooststr. Convolvulaceae

1. The tuber is edible after roating on hot ashes.
   Rogu, Rowu (Djambarrpuyngu) Milingimbi NMS 508 & GMW.
2. The leaves are heated on hot stones and placed directly over the affected part or they are boiled in water and the liquid used as a wash for the treatment of skin sores, skin disorders or scabies.
   Gonara (Burarra) Maningrida NMS 520, NMS 641 & GMW; **Murnmurnka** (Iwaidja) Minjilang NMS 151 & GMW; **Rowu** (Djambarrpuyngu) Galiwinku NMS 168, NMS 589; **Wurakinni** (Tiwi) Pularumpi NMS 1267.
3. Heated leaves can be applied directly over bad cuts to stop the bleeding.
   Rogu, Rowu (Djambarrpuyngu) Milingimbi NMS 508 & GMW.
4. Heated leaves can be placed directly on the forehead to relieve bad headaches. Replace as often as required.
   Balkbalkbi (Batjamal), **Ramarratj** (Emi) Belyuen NMS 836, NMS 1028.
5. The heated leaves are placed directly onto marine stings, especially stingray and stonefish stings to relieve the pain. Repeat as the pain returns.
   Rowu (Djambarrpuyngu) Galiwinku NMS 168, NMS 589; **Rowu, Rogu** (Djambarrpuyngu) Milingimbi NMS 508 & GMW; ? (Gaalpu/Kunwinjku) Warruwi NMS 133 & GMW; **Murnmurnka** (Iwaidja) Minjilang NMS 151 & GMW; **Ngul pindal** (Murrinh-Patha) Wadeye NMS 482.
6. Fresh leaves are boiled in water and the liquid is drunk for relief from bad colds and coughs.
   Karkumgun (Tiwi) Paru NMS 562 & GMW.

Ipomoea racemigera F. Muell. & Tate Convolvulaceae

1. The long tuberous rootstock is considered a tasty vegetable food after roasting on hot coals.
   Artung (Pitjantjatjara) Apatula NMS 1190.

Isotoma petraea F. Muell. Campanulaceae

1. The leaves are smoked or crushed and inhaled. This helps people to climb hills and to continue walking when they are tired. It helps the chest breathe a little easier when walking up hills.
2. Considered to cause temporary blindness if it gets into your eyes.
   Tjuntiwari (Yankunytjatjara) Ulpulla NMS 1358.

Jacksonia dilatata Benth. Fabaceae

1. The inner bark and stem are scraped into a container of hot water(the water was in the past heated with hot stones), or boiling water. The liquid is cooled then drunk and used as a body wash with a little placed in each ear as an effective cure for diarrhoea. This is a commonly used medicine today.
   Bil'pil (Djambarrpuyngu) Galiwinku NMS 167.

Leea rubra Blume ex Sprengel Leeaceae

1. The stems are used as fire sticks.
2. The fruit is eaten raw when ripe (black).
   Dhalarrmung (Djambarrpuyngu) Milingimbi GMW 3334 & NMS.

Lepidium phlebopetalum (F. Muell.) F. Muell. Brassicaceae

1. The whole plant is eaten raw as a leafy vegetable or it can be used as a food flavouring when cooking meats.

2. Eaten raw the plant will cure any unknown sickness; especially if you have been sick a long time.
   Unmuta (Pitjantjatjra) Apatula NMS 1171.

Leptospermum parviflorum Valeton Myrtaceae

1. The leaves are boiled in water and the liquid is used as a hair wash to make the hair grow if you are balding and as a hair conditioner to make it shiny and healthy.
   ? (Djambarrpuyngu) Galiwinku; **?** (Gupapuyngu) Darwin.

Limnophila brownii Wannan Scrophulariaceae

1. Considered to be a strong smelling plant; use unknown.
   Djewul (Djambarrpuyngu) Milingimbi GMW 4386 & NMS.

Limnophila sp. Scophulariaceae

1. A handful of leaves are crushed and the vapours inhaled to clear up any sinus trouble associated with colds and influenza.
   ? (Kunwinjku) Maningrida NMS 653 & GMW.

Litsea glutinosa (Lour.) C. Robinson Lauraceae

1. The wood from this species makes an excellent axe handle.
   Muyu (Batjamal/Emi) Belyuen NMS 821, NMS 1402, NMS 1420.
2. The leaves can be crushed in the hand and the vapours inhaled to relieve the feelings of sickness (nausea).
   Butjiringaning (Djambarrpuyngu) Galiwinku NMS 593; **Butjiringaning** (Djambarrpuyngu) Milingimbi NMS 511 & GMW.
3. The leaves can be boiled in water and the liquid drunk to relieve the feeling of nausea and to control vomiting.
   Butjiringani (Yolngu Matha) Yirrkala.

Livistona humilis R. Br. Arecaceae

1. The centre stem and the young growing point of this palm is heated on hot coals, smashed and then chewed(although not necessarily eaten) to relieve chest infections.
   Miparri (Tiwi) Pularumpi NMS 1274.
2. The inner white stem chewed or it can be boiled in water and the liquid drunk for relief from sore throats.
   Marlinkarrk (Iwaidja) Minjilang NMS 157 & GMW.
3. The stem and young growing point can be chopped, cleaned and boiled in water till soft then eaten.
   Bulgay (Burarra) Maningrida GMW ? & NMS; **Merreppen** (Batjamal/Emi) Belyuen NMS 849; **Merreppen** (Ngankikurungkurr) Nauiyu Nambiyu NMS 1008.
4. The leaves are stripped, dried and rolled to make a strong string for making dilly bags and fishing nets.
   Merreppen (Ngankikurugkurr) Nauiyu Nambiyu NMS 1008.
5. The young basal sections of the leaves are dipped into wild bee honey and eaten.
   Miparri (Tiwi) Pularumpi NMS 1274.
6. The fruits are used to produce a dark coloured dye for colouring objects woven from the leaves of *Pandanus* spp..
   Dhalpi (Djambarrpuyngu) Milingimbi GMW 3486 & NMS.

Livistona sp. Arecaceae

1. The centre 'heart' or growing point of the palm can be eaten raw, roasted or boiled.
2. The large leaves are used to cover meats when cooking in bush earthern ovens.
3. The leaves are used as placemats for food and for sitting on.
   Nyulpa (Ngarinyman) Bulla NMS 1126.

Lobelia quadrangularis R. Br. Campanulaceae

1. The dried plant can be chewed as a bush tobacco. Often it is mixed with some commercially available chewing tobacco (*Nicotiana tabacum*) and some burnt bark (ash) of *Eucalyptus camaldulensis*.
   Jarrinymawu [means cave-dweller] (Ngarinyman) Aminbidji, Bulla NMS 1146.

Lophostemon grandiflorus (Benth.) Peter Wilson & Waterhouse Myrtaceae

1. This species is one of the favoured hosts for the native bee nests. The honey and pollen collected have both nutritional and medicinal values as a cure for diarrhoea.The bee is called **murnuwi** and the honey **ngarlu.**
   Jingkulng (Ngarinyman) Bulla NMS 918, NMS 927.

Lophostemon lactifluus (F. Muell.) Peter Wilson & Waterhouse Myrtaceae

1. The wood is utilised, (possibly to manufacture axe handles?).
   Bernang (Batjamal), **Minymirr** (Emi) Belyuen NMS 797.

Lumnitzera littorea (Jack) Voigt Combretaceae

1. The stems are used to manufacture digging sticks and throwing sticks to kill geese.
   Tjerwi, Thirwi (Batjamal), **Ra** (Emi) Belyuen NMS 812.

Lysiana subfalcata (Hook.)Barlow Loranthaceae

1. The fruit is eaten raw when ripe; considered very sweet and is eagerly sought after by children.
   Ngantja (Yankunytjatjara) Ulpulla NMS 1370.

Lysiphyllum cunninghamii (Benth.) De Wit Caesalpiniaceae

1. The roots can be scraped clean, crushed and boiled in water. The liquid is used as a very effective antiseptic wash for sores of the skin and as a treatment for scabies.
   Wanyarri=tree, **winduru**=root (Jingulu/Mudburra) NMS 686, NMS 962.
2. The red inner bark is boiled in water and the liquid drunk and used as a body wash for the treatment of headaches, high temperatures, fever and for general sickness.
   Wanyarri (Ngarinyman) Aminbidji NMS 1136; **Wanyarri** (Ngarinyman) Bulla NMS 727.
3. The nectar is sucked from the flowers for its sweet taste.
4. Some part of this species has been used as a poison in the past i.e. in a payback system.
   Wanyarri (Mudburra) Elliott NMS 962.
5. This species is a favoured host of the native bee nests, which are eagerly sought for their honey.
   Wanyarri (Jingulu/Mudburra) Elliott NMS 686, NMS 962; **Wanyarri** (Ngarinyman) Aminbidji NMS 1136, Bulla NMS 727.

Macaranga tanarius (L.) Muell. Arg. Euphorbiaceae

1. The stems are used to manufacture spear shafts; the bark is peeled off and the shafts straightened by heating over hot coals and bending. The timber is light and ideal for small fishing spears.
   Walala (Batjamal/Emi) Belyuen NMS 817.

Macropteranthes kekwickii F. Muell. Combretaceae

1. The wood is extremely hard and makes an excellent woomera or boomerang.
2. A favoured source of firewood as it is slow burning, producing a very hot fire.
   Kamanji (Jingulu) Elliott NMS 983; **Kumunji** (Waramungu) Elliott NMS 687.

Maranthes corymbosa Blume . Chrysobalanaceae

1. The straight trunks are used to manufacture sea-going canoes.
   Bernang (Batjamal), **Minymirr** (Emi) Belyuen NMS 834.

Marsdenia australis R. Br. Asclepiadaceae

1. The young fruits are eaten after they have been lightly roasted on hot ashes.
   Ngimirrikimi (Jingulu) Elliott NMS ?; **Kilibi** (Mudburra) Elliott; **Kirlipi** (Ngarinyman/Mudburra) Bulla NMS 941.

Marsdenia cinerascens R. Br. Asclepiadaceae

1. This plant is considered to be poisonous and its fruits should not be confused with the edible fruits of *Marsdenia australis*.
   ? (Ngarinyman) Bulla NMS 1085.

Marsdenia velutina R. Br. Asclepiadaceae

1. The stems can be used as an emergency supply of string or rope.
   ? (Ngalkbun) Barunga NMS 356.

Melaleuca acacioides F. Muell. Myrtaceae

1. Fresh leaves are boiled in water and the liquid drunk after meals to relieve coughs and colds. The mixture can be made and stored in a bottle for up to a week.
   Gulu gulun (Rembarrnga?) Gulin Gulin NMS 241.
2. The leaves are crushed in the hand and the vapours inhaled to clear a blocked sinus and for relief from head colds.
   Gulun'kulun (Djambarrpuyngu) Milingimbi NMS 504 & GMW.

Melaleuca argentea W. Fitzg. Myrtaceae

1. The papery bark is used for building shelters.
   Pakarli (Ngarinyman) Bulla NMS 912.
2. Fresh leaves are boiled in water and the liquid is used as a body wash to relieve headaches, colds, influenza and for general sickness.
   Arbinjirri (Yanyula) Borroloola NMS 1217, NMS 1260.
3. Flying foxes often rest in these trees at the billabong. The young flying foxes fall into the water and are eaten by crocodiles so you should keep away from these trees at the waters edge.
   Pakarli (Ngarinyman) Bulla NMS 740.

Melaleuca cajuputi Powell — Myrtaceae

1. Fresh leaves can be crushed in the hand and the vapours inhaled to relieve sinus trouble and for relief from coughs, colds, influenza and fever.
2. The leaves can be boiled in water. The inhalation of the vapours and the use of the liquid as a body wash will cure coughs, colds and influenza.
   Wara (Batjamal), **Werletj** (Emi) Belyuen NMS 848, NMS 1400; **Jikara** (Burarra), **Rangan** (Djinang) Maningrida NMS 636 & GMW; **Bardarr** (Djambarrpuyngu) Ramingining NMS 654 & GMW; **Nambarra** (Yolngu Matha) Yirrkala NMS 181.

Melaleuca leucadendra (L.)L. — Myrtaceae

1. Layers of papery bark are boiled in water and the liquid is drunk to relieve bad headaches associated with colds and influenza as well as for the treatment of fever.
   Wolk' (Yolngu Matha) Yirrkala NMS 217.
2. The papery bark is used for things such as holding water, food when cooking in earthen bush ovens and for lining coolamons to carry babies.
   Rangan (Djambarrpuyngu) Galiwinku NMS 581; **Rangan** (Djambarrpuyngu) Milingimbi GMW 3429 & NMS; **Pakarli** (Ngarinyman) Bulla NMS 908.
3. The thicker sections of the papery bark are used to build houses.
   Rangan (Djambarrpuyngu) Milingimbi GMW 3429 & NMS; **Pakarli** (Ngarinyman) Bulla NMS 908.
4. Fresh leaves are crushed in the hand and the vapours inhaled to relieve sinus trouble and colds.
   ? (Batjamal), **Thiyel** (Emi) Belyuen NMS 822.
5. Fresh leaves are crushed and boiled in water. The liquid is used as a body wash for relief from colds, influenza and fever.
   Rangan (Djambarrpuyngu) Galiwinku NMS 581; **Pakarli** (Ngarinyman) Bulla NMS 908.
6. Fresh leaves are boiled in water and the liquid is drunk to treat general sickness of an unknown cause especially any internal pain.
7. Fresh leaves are placed in a pit over hot coals and allowed to smoke. The patient sits close to the fire and allows the smoke to flow all around, making sure some is inhaled. This is considered an effective cure for general sickness of unknown causes and for relief from the symptoms of colds and influenza.
   Pakarli (Ngarinyman) Bulla NMS 908.

Melaleuca minutifolia F. Muell. — Myrtaceae

1. The papery bark is used to make carrying containers.
2. This species is one of the favoured hosts for the native bee nests. The honey and pollen collected has both nutritional and medicinal value as a cure for diarrhoea.
   Mangkalng (Ngarinyman) Bulla NMS 924.

Melaleuca nervosa (Lindley) Cheel — Myrtaceae

1. The trunk of this species is often swollen containing copious quantities of fresh water. The base of the swollen section is cut with an axe and the water gushes out under pressure. The water is used during the dry season especially when walking long distances overland where there is a lack of surface water.
   Wa (Ngankikurungkurr) Nauiyu Nambiyu NMS 452.

Melaleuca stenostachya S.T. Blake — Myrtaceae

1. Fresh leaves are boiled in water and the liquid is used as a medicinal body wash for relief from colds, influenza and for general sickness of an unknown cause. This medicine is still commonly used today.
   Marlulu (Yanyula) Borroloola NMS 1262.

Melaleuca viridiflora Sol. ex Gaertner Myrtaceae

1. The papery bark is used to make containers, for lining coolamons when carrying babies and for wrapping food when cooking.
2. The thicker sections of the papery bark are used for building houses.
3. The timber is considered very durable and is used for fence posts, railings and building shelters.
   Manbidubidu (Kunwinjku) Jabiru NMS 1460; **Jiyil** (Ngarinyman) Bulla NMS 1102.
4. Fresh leaves are crushed in the hand and the vapours inhaled or the the leaves are crushed and soaked in water and the vapours given off inhaled to relieve sinus trouble, head colds and influenza.
   Dhoku (Djambarrpuyngu) Milingimbi NMS 506 & GMW.
5. Fresh leaves are boiled in water and the liquid used as a medicinal body wash for relief from headaches, fever and the symptoms of colds and influenza including general body aches and pains.
   Pudebude, Rakala (Dalabon/Ngalkbun) Barunga NMS 347; **Larruk** (Jawony) Barunga NMS 347; **Warrkarr** (Yanyula) Boroloola NMS 1257.
6. Fresh leaves are boiled in water and the liquid is used as an antiseptic wash for sores of the skin and infected cuts.
   Pudebude, Rakala (Dalabon/Ngalkbun) Barunga NMS 347; **Larruk** (Jawony) Barunga NMS 347.
7. This species often has swollen trunks which contain water that can be drunk when walking long distances overland during the dry season. The water contains a lot of minerals that quench the thirst and act as a mineral replacement drink when dehydrated.
   Manbidubidu (Kunwinjku) Jabiru NMS 1460.
8. This species is one of the favoured hosts for the native bee nests. The honey and pollen has both nutritional and medicinal value as a cure for diarrhoea.
   Jiyil (Ngarinyman) Bulla NMS 932.

Melastoma affine D. Don Melastomaceae

1. Fresh leaves are placed over water containers to keep it cool and to stop it spilling when travelling.
   ? (Tiwi) Nguiu GMW 3567 & NMS.

Mnesithea rottboellioides (R. Br.) Koning & Sosef Poaceae

1. The rhizomes are edible after roasting on hot coals.
2. The leaves and culms are chopped and boiled in water. The liquid is used as an antiseptic wash for sores of the skin.
3. The culms are used by children to make spears.
   Marurt (Ngarinyman) Bulla NMS 1123.
4. The culms are chewed and sucked to provide sweet sap as well as a source of water when travelling overland during the dry season.
   Keltje (Batjamal), **Ngula** (Emi) Belyuen NMS 823; **Marurt** (Ngarinyman) Bulla NMS 1123.

Momordica balsamina L. Cucurbitaceae

1. The fruit is eaten raw when ripe (red); the black seeds are spat out.
   Marmarndja (Yanyula) NMS 1226.

Morinda citrifolia L. Rubiaceae

1. The root is chopped and boiled in water to produce a yellow dye. Mainly used for colouring baskets, mats and string dilly bags.
   Guninyi, Burukpili (Djambarrpuyngu) Milingimbi NMS 500 & GMW, NMS 503 & GMW; **Guninyi, Burukpili** (Djambarrpuyngu) Ramingining NMS 657 & GMW; **Alaymaykbya, Manngukmayin** (Kunwinjku) Maningrida NMS 651 & GMW.
2. The ripe friuts are eaten raw as a cure for sore throats and bad coughs.
   Burukpili (Djambarrpuyngu) Galiwinku; **Guninyi, Burukpili** (Djambarrpuyngu) Milingimbi NMS 500 & GMW, NMS 503 & GMW; **Guninyi, Burukpili** (Djambarrpuyngu) Ramingining NMS 657 & GMW; **?** (Gaalpu/Kunwinjku) Warruwi NMS 134 & GMW; **Alaymaykbya, Manngukmayin** (Kunwinjku) Maningrida NMS 651 & GMW; **Burukpili** (Yolngu Matha) Yirrkala NMS 216.
3. The fruit is eaten raw when ripe and soft; often they are collected from the ground.
4. The fruit is used medicinally to treat asthma; eating one fruit is considered to be enough to cure most asthma cases.
   Meyak (Batjamal), **Menymi** (Emi) Belyuen NMS 820.

Mukia maderaspatana (L.) M. Roemer Cucurbitaceae

1. The fruit is not considered to be edible by humans.
2. Considered to be a shady creeper hence a good place to camp under.
   ? (Pitjantjatjara) Apatula NMS 1196.

Nauclea orientalis (L.) L. Rubiaceae

1. The fruit is eaten raw when soft and ripe.
2. Turtles and fish eat this fruit making them fat. Therefore when this tree is fruiting it is a good time to go hunting for both fish and turtle.
   Jampa (Ngarinyman) Bulla NMS 1068.

Nelumbo nucifera Gaertner Nelumbonaceae

1. The fruiting capsule and seeds are eaten raw or after roasting on hot ashes.
2. The whole plant has sacred and ceremonial significance for women.
   ? (Ngankikurungkurr) Nauiyu Nambiyu.

Nicotiana occidentalis Wheeler ssp. ***obliqua*** N. Burb. Solanaceae

1. This species is dried and chewed with some ash (burnt bark of certain *Eucalyptus* spp.) to produce a stimulant or narcotic effect. Sometimes this plant is chewed by children to get them used to the idea of chewing pituri. If the plant breaks when folded in half it is considered to be strong enough for adults to use; however if it bends without snapping it is considered to be weak and thus suitable to give to children.
   Pituru ? (Pitjantjatjara) Apatula NMS 1203.

Nymphaea gigantea Hook. Nymphaeaceae

1. The corms are eaten after they have been roasted on hot coals.
2. The flowering stems are used as a drinking straw to extract fresh water from waterholes.
3. The flowering stems are peeled and eaten raw (as with celery).
4. The seeds are ground on grinding stones into a fine flour for making damper.
   Jirrch=young tubers, **Bubuga**=old corms, **Mijagarlawurr, Mun-giji**=stems (Burarra) Maningrida GMW 3858 & NMS.

Nymphaea macrosperma Merill & Perry Nymphaeaceae

1. The corms are eaten after they have been boiled in water or after roasting on hot coals.
2. Two or three of the cooked tubers will, when eaten, cure diarrhoea.
3. Damper or flat bread is cooked between the large leaves of this species to protect it from dirt and ashes in the fire.
4. The flowering stem is eaten raw, sometimes the outside is peeled off before eating.
5. The fruiting capsule is eaten raw or after roasting on hot coals or hot stones.
6. Two or three of the cooked fruiting capsules will, when eaten, cure diarrhoea.
7. The small seeds are ground on grinding stones to produce a fine flour for making damper.

Kanyngurininy=whole plant, **Rarrang**=fruiting capsule (Ngarinyman) Bulla NMS 763.

Nymphaea sp. Nymphaeaceae

1. The corm is eaten after it has been roasted on hot coals.
2. Two or three of the cooked corms are eaten as a cure for diarrhoea.
3. The flowering stems are eaten raw.

Jikamuru (Ngarinyman) Bulla NMS 736.

Nymphaea violacea Lehm. Nymphaeaceae

1. The flowering stems are eaten raw.

Karrtjara=stem, **Walang**=whole plant (Batjamal) Belyuen NMS 851; **Dhulumburrk** (Djambarrpuyngu) Milingimbi GMW 3430 & NMS.

Nymphoides indica (L.) Kuntze Menyanthaceae

1. The corms or possibly seeds are eaten as a cure for diarrhoea? (This information needs further checking).

Kanynguriny (Ngarinyman) Bulla NMS 731.

Operculina aequisepala (Domin)R.W. Johnson Convolvulaceae

1. The tuber has in the past been eaten after roasting on hot ashes.

? (Ngarinyman) Bulla NMS 1087.

Opilia amentacea Roxb. Opiliaceae

1. The fruits are eaten raw when they are ripe (red). They are considered 'wet season tucker.'

Mirliny (Ngarinyman) Bulla NMS 755.

Osbornia octodonta F. Muell. Myrtaceae

1. A small section of inner bark is forced into a tooth cavity for the relief of pain from bad toothache. This remedy is not used much nowadays, people prefer to use *Buchanania obovata*. q.v.

Dhurrurirgitj (Yolngu Matha) Yirrkala NMS 218.

Owenia vernicosa F. Muell. Meliaceae

1. The inner bark is chopped, pounded and thrown onto the surface of fresh water holes as a fish poison. The fish rise to the surface and can be easily collected and thrown onto the banks.
   Barnarr (Jawony/Ngalkbun) Barunga NMS 335; **Barnarra** (Rembarrnga?) Gulin Gulin NMS ?.
2. The red inner bark is boiled in water and the liquid is used as an antiseptic wash for open cuts and sores of the skin.
3. Emu eat the fruit; they are not considered to be edible by humans.
   Purnarr[t?] (Ngarinyman) Bulla NMS 741, NMS 902, NMS 1093; ? (Yanyula) Borroloola NMS 1220.

Pandanus spiralis R. Br. sens. lat. Pandanaceae

1. Two six inch lengths of prop roots are chopped and boiled in water. The liquid is used as a medicinal wash to treat scabies. This wash is considered too strong for babies.
   Jangawa (Ngarinyman) Bulla NMS 734.
2. Upper young sections of the stem and growing point can be roasted and chewed, although not necessarily eaten, as a cure for abdominal pain and diarrhoea.
3. Upper young sections of the stem can be heated on hot coals and held tightly against any painful area of the stomach for relief from abdominal pain.
   Miyaringa (Tiwi) Pularumpi NMS 1265.
4. The upper young sections of the stem are cleaned of leaf bases, pounded flat and either boiled or heated on hot coals. The hot poultice is then applied to any area of the body for pain relief, e.g. pain in back, neck, ribs, joints, often it is held in place with a tight bandage for 1-2 days. It is replaced when the pain returns.
   Ginmenima=whole plant, **An-jungupur**=stem (Burarra) Maningrida NMS 637; **?** (Gaalpu/Kunwinjku) Warruwi NMS 129 & GMW.
5. The main growing point is chopped and boiled in water to produce a green dye. Often used to colour bags and mats made from *Pandanus* leaves.
   Gunga, **Manhara** (Djambarrpuyngu) Milingimbi NMS 513 & GMW.
6. The white basal sections of the leaves can be eaten as a cure for abdominal pain and diarrhoea.
   Miyaringa (Tiwi) Pularumpi NMS 1265.
7. The soft white basal sections of the leaves can be chewed as a cure for sores in the mouth and sore throats. This is still a very commonly used treatment.
   Gunga, **Manhara** (Djambarrpuyngu) Milingimbi NMS 513 & GMW; **Makunguk** (Djambarrpuyngu) Galiwinku NMS 165; **Gunga** (Djambarrpuyngu) Ramingining NMS 659 & GMW; **Gunga** (Yolngu Matha) Yirrkala NMS 182.
8. The soft white basal ends of the leaves can be crushed and mixed with a little water. The mixture is applied directly onto sores of the skin as an antiseptic.
   Makunguk (Djambarrpuyngu) Galiwinku NMS 591.
9. The soft white basal ends of the leaves can be chopped and boiled in water. The liquid is strained and droppered into the eyes to relieves soreness and to kill infections. Use only those plants growing out on the sandy flats for this medicine as those growing by the waters edge are too strong.
   Jangawa (Ngarinyman) Bulla NMS 734.
10. The soft white basal ends of the leaves are eaten raw as a food source.
    Makunguk (Djambarrpuyngu) Galiwinku NMS 165, NMS 591; **Gunga**, **Manhara** (Djambarrpuyngu) Milingimbi NMS 513 & GMW; Anburari (Iwaidja) Minjilang NMS 129 & GMW; **Jangawa** (Ngarinyman) Bulla NMS 734.
11. The leaves can be stripped into thin sections, tied very tightly around the end of a stick, heated on hot coals,then pressed very firmly onto the stomach to relieve abdominal pain.

12. Thin strips of the leaves can be tied very tightly around the head to relieve headaches.
 Miyaringa (Tiwi) Pularumpi NMS 1265.
13. The leaves are stripped in thin strips, dried in the sun for about an hour and then used to weave bracelets, fans, mats, bags and baskets.
 Nyurratj (Batjamal), **Yerre** (Emi) Belyuen NMS 1054; **Ginmenima** (Burarra) Maningrida NMS 637; **Manbelk** (Kunwinjku) Jabiru NMS 1467; **Makunguk** (Djambarrpuyngu) Galiwinku NMS 165; **Manhara**, **Gunga** (Djambarrpuyngu) Milingimbi NMS 513 & GMW; **Gunga** (Djambarrpuyngu) Ramingining NMS 659 & GMW.
14. The fruits are roasted, soaked in water, then placed on the lower back covered with a cloth to relieve back ache.
 Gunga (Yolngu matha) Yirrkala NMS 182.
15. The red or yellow flesh at the base of fresh phalanges (fruits) is eaten raw.
 ? (Gaalpu/Kunwinjku) Warruwi NMS 129 & GMW; **Gunga** (Yolngu Matha) Yirrkala NMS 182.
16. The seeds are eaten raw or roasted; the phalange (fruit) is split open with axe and the seed is picked out with a sharp stick or a piece of wire. Although time consuming to obtain the seeds are still a commonly utilized food source.
 Nyurratj (Batjamal), **Yerre** (Emi) =tree, **Nguk** (Batjamal), **Yerrem** (Emi)=fruit Belyuen NMS 1054; **Ginmenima**=whole plant, **An-jungupur**=main stem, **Jinga**=fruit (Burarra) Maningrida NMS 673; **Manbelk** (Kunwinjku) Jabiru NMS 1467; **Makunguk** (Djambarrpuyngu) Galiwinku NMS 591; **Manhara, Gunga**=tree, **Gutu**=seeds (Djambarrpuyngu) Milingimbi NMS 513 & GMW; **Gunga** (Djambarrpuyngu) Ramingining NMS 659 & GMW; **Jangawa** (Ngarinyman) Bulla NMS 734; **Miyaringa** (Tiwi) Pularumpi NMS 1265.

Pandorea doratoxylon (J. Black) J. Black — Bignoniaceae

1. The straighter of the stems are made into spears. They are heated over hot coals then straightened whilst hot. Short sections can be spliced together to make the desired length. The joint is wrapped tightly with kangaroo sinew which has been dried in the sun then re-moistened by chewing. The sinew is covered with hot ashes to make sure it shrinks sufficiently to make a very tight bond. The joint is then covered with resin made from *Acacia aneura* var. *latifolia* and allowed to harden. The barb or blade made from *Acacia aneura* var. *aneura* is added and bonded with resin. These spears were being made at the time of collection of this information mainly as a teaching exercise for the young people; they were then to be sold commercially. Most hunting is nowadays carried out with a rifle.
 Urtjan (Yankunytjatjara) Ulpulla NMS 1365.

Paramignya trimera (Oliver) Burkill — Rutaceae

1. The fruit is eaten raw when ripe (red).
 name not in use at time of recording (Djambarrpuyngu) Milingimbi GMW 3505 & NMS.

***_Passiflora foetida_** L. — Passifloraceae

1. A few fresh leaves are rubbed onto a patch of ringworm as a cure. This species is native to the West Indies and South America.
 Wulungari (Ngarinyman) Bulla NMS 1122.
2. Immature fruits are crushed and rubbed onto the skin to treat ringworm and fungal infections; the skin is roughened with leaves of *Ficus opposita* prior to treatment.
3. Ripe fruits can be eaten as an asthma cure, to help the breathing.
 Bulppul (Batjamal/Emi) Belyuen NMS 833, NMS 1040.

4. The fruits are eaten raw when ripe (yellow). They are not to be eaten green.
Bulppul (Batjamal/Emi) Belyuen NMS 833, NMS 1040; **Ganga** (Djambarrpuyngu) Milingimbi GMW 3516 & NMS; **Wulungari** (Ngarinyman) Bulla NMS 1122; **?** (Tiwi) Darwin.

Perotis rara R. Br. Poaceae

1 No use recorded; language name may be a generic term for grasses.
Yuka (Mudburra) Elliott.

Persoonia falcata R. Br. Proteaceae

1. The inner bark and some stem wood is scraped into water and boiled (heated stones can be added to make it boil faster). The liquid is used as eye drops for relief from sore red eyes.
Dangapa (Djambarrpuyngu) Galiwinku NMS 171; **Dangapa** (Yolngu Matha) Yirrkala NMS 186.
2. Some leaves are crushed and boiled in water. Fresh leaves can be dipped into the liquid and chewed as a cure for thrush of the mouth and a little of the liquid can be sipped for relief from bad chest infections and coughs.
Jimijinga (Tiwi) Paru NMS 563 & GMW; **Jimijinga** (Tiwi) Pularumpi NMS 1268.
3. The fruit is eaten raw when ripe (pale yellow/green).
Tjiwekbe (Batjamal), **Thelh-lerl** (Emi) Belyuen NMS 791; **Bololo** (Dalabon/Jawony/Ngalkbun/)Barunga NMS ?; **Dangapa** (Djambarrpuyngu) Galiwinku NMS 171; **Dangapa** (Djambarrpuyngu) Milingimbi NMS 736 & GMW; **Dangapa** (Yolngu Matha) Yirrkala NMS 186; **Mi katan** (Murrinh-Patha) Wadeye NMS ?; **Jimijinga** (Tiwi) Paru NMS 563; **Jimijinga** (Tiwi) Pularumpi NMS 1268.

Petalostigma pubescens Domin Euphorbiaceae

1. The immature fruits are collected by children and are used as toys, particularly as marbles.
Marlungkaru (Jingulu/Mudburra) Elliott.

Petalostigma quadriloculare F. Muell. Euphorbiaceae

1. The leaves and fruits are crushed and infused in water. The liquid is used as an antiseptic wash for sores, cuts and skin ailments such as scabies, and itchy red skin.
Kunul (Batjamal/Emi) Belyuen NMS 841.
2. The fruits are considered to be very poisonous.
? (Jawony) Barunga NMS 544.

Philydrum lanuginosum Banks & Sol. ex Gaertner Philydraceae

1. The whole plant is boiled in water and the liquid is used as an antiseptic wash for sores of the skin and to treat skin conditions such as scabies and skin allergies. Often used in a bath to treat babies. This medicine is still commonly used today.
? (Yolngu Matha) Yirrkala NMS 215.
2. Fleshy herb, no use recorded.
Berrungberrung (Batjamal/Emi) Belyuen NMS 835.

******Physalis minima* L. Solanaceae

1. The fruit is eaten raw when ripe (purple). This is possibly not a native species and has no specific Aboriginal name. It is also widespread in tropical America, Asia and Africa.
? (Yanyula) Borroloola NMS 1212; **?** (Tiwi) Darwin NMS 1324.

Planchonia careya (F. Muell.) Kunth Lecythidaceae
1. The red inner bark is boiled in water and the liquid is used as an antiseptic wash for sores and cuts.
   Wartuluj (Iwaidja) Minjilang NMS 159 & GMW.
2. The red inner bark is chopped and thrown onto the surface of fresh water holes as a fish poison. The 'stunned' fish rise to the surface and can be easily thrown out onto the banks.
   Dhanggi (Yolngu Matha) Yirrkala.
3. The leaves are heated and placed over mosquito and sandfly bites to relieve the soreness and itchyness.
4. The flowers are used as decorations.
   Dhanggi (Djambarrpuyngu) Milingimbi GMW 3488 & NMS.
5. The fruits are eaten raw when ripe (soft and green).
   Melberre (Batjamal) Belyuen NMS 801; **Dhanggi** (Djambarrpuyngu) Milingimbi GMW 3488 & NMS; **Peletji** (Emi) Belyuen NMS 1408; **Wartuluj** (Iwaidja) Minjilang NMS 159 & GMW; **Mi palathi** (Murrinh-Patha) Wadeye NMS 475; **?** (Tiwi) Darwin NMS 272; **Dhanggi** (Yolngu Matha) Yirrkala.

Pleomele angustifolia (Medikus) N.E. Br. Agavaceae
1. The leaves are boiled in water and the liquid used as an antiseptic wash for sores of the skin and bad cuts.
   ? (Kunwinjku) Maningrida NMS 652 & GMW.

Pogonolobus reticulatus F. Muell. Rubiaceae
1. The yellow inner root bark is crushed and boiled in water to produce a yellow dye; the colour is darkened by the addition of burnt bark ash as a mordant. Commonly used to colour baskets made from *Pandanus* leaves and for string bags.
   Dyindji (Batjamal/Emi) Belyuen NMS 842; **Wakngani** (Djambarrpuyngu) Milingimbi GMW 3833 & NMS; **Mandjundum** (Kunwinjku/Rembarrnga) Maningrida NMS 645 & GMW; **Kala** (Ngankikurungkurr) Nauiyu Nambiyu NMS 445.
2. The fruit are eaten raw when ripe (purple).
   Mandjundum (Kunwinjku/Rembarrnga) Maningrida NMS 645 & GMW.

Pongamia pinnata (L.) Pierre Fabaceae
1. Considered a good shady tree to camp under, especially in coastal areas.
   Kemenggat (Batjamal), **Arrmungarra** (Emi) Belyuen GMW 4513 & NMS.

Portulaca oleracea L. Portulacaceae
1. The tuberous root stock can be cleaned, roasted on hot coals, then eaten.
2. The stems and leaves are eaten raw or after they have been lightly heated on hot stones or coals.
3. The seeds are winnowed and ground on stones into a flour to make damper or small cakes.
   Wakati (Yankunytjatjara) Ulpulla NMS 1376.

Portulaca pilosa L. Portulacaceae
1. The tuberous rootstock is eaten raw or after it has been roasted on hot coals. The outer skin can, if desired, be peeled before eating.
   Pilnanginma (Batjamal/Emi) Belyuen NMS 1156; **Juraymia** (Warumungu) Elliott NMS 967.

Pouteria sericea (Aiton) Baehni Sapotaceae

1. The fruits are eaten raw when ripe (deep purple); they are a highly sought after food although not available in large quantities.
? (Batjamal/Emi) Belyuen NMS 1057; **Birayngu** (Djambarrpuyngu) Milingimbi GMW 3428 & NMS; **Wungapu** (Djambarrpuyngu) Darwin NMS 250; **?** (Gaalpu/Kunwinjku) Warruwi GMW 3154 & NMS; **Naalij** (Ngarinyman) Bulla NMS 751; **Wungapu** (Yolngu Matha) Yirrkala NMS ?.

Premna acuminata R. Br. Verbenaceae

1. Branches are used as drills which are rubbed back and forth between the palms to provide heat to start fires.
Ngarrik (Batjamal), **Mintharra** (Emi) Belyuen GMW ? & NMS.

2. The stems are hollowed out to make pipes for smoking. The are mainly sold to provide a source of income.
Duttji (Djambarrpuyngu) Milingimbi GMW 3335 & NMS.

Premna serratifolia L. Verbenaceae

1. The branches are used as drills which are rubbed back and forth between the palms to provide heat to start fires.
Mintharra (Batjamal), **Ringanang** (Emi) Belyuen GMW 4514 & NMS.

Prostanthera striatiflora F. Muell. Lamiaceae

1. Fresh leaves are boiled in water and the liquid used as a medicinal body wash for relief from colds and influenza.

2. To clear blocked sinuses fresh leaves are boiled in water and the vapours inhaled or branches are laid over a pit of hots coals and the smoke and fumes inhaled.
? (Eastern Aranda) Ltyentye Purte NMS 313.

3. Fresh leaves are crushed and rubbed all over the body, especially the chest, to treat for any sort of chest or lung problem.
Karingana (Yankunytjatjara) Ulpulla NMS 1357.

Protasparagus racemosus (Willd.) Oberm. Liliaceae

1. The roots are cleaned,peeled of the outer skin then boiled in water.The liquid is used as a medicinal wash for skin sores, infected cuts and any skin disorders such as scabies.
Nakinnaki (Iwaidja) Minjilang NMS 153 & GMW ; **Mundurri** (Tiwi) Paru NMS 560 & GMW; **Mayagarrdi** (Yanyula) Borroloola NMS 1244.

2. A few tuberous roots are crushed and rubbed onto the breasts to reduce swellings, take away lumps and to treat breast cancer.
? (Malak-Malak) Wooliana NMS 440.

3. The straighter stems are used as fire sticks and for fire wood.
Dapu (Djambarrpuyngu) Milingimbi GMW 3426 & NMS.

4. No use recorded. However the language names for this species refer to the thorns on the stem which resemble dogs teeth.
Muyiny (Batjamal), **Mitjirrirri** (Emi) Belyuen NMS 818.

Pterocaulon globuliflorus W. Fitzg. Asteraceae

1. The leaves and stems are boiled in water and the liquid used as a medicinal wash for relief from bad colds, influenza and fever. It can also be used to soothe itchy skin and to treat ringworms.

2. Branches are placed on a fire and allowed to smoke. The patient sits close by allowing the smoke to flow all around, making sure some is also inhaled. This is considered a very good treatment for bad colds, influenza and to clear a blocked sinus. The plants growing at the entrance to caves on the sandstone escarpments are considered to make the strongest medicine and to treat really bad cases of sickness plants from that location will need to be collected.
   Ngurnungurnung (Ngarinyman) Bulla NMS 1081.

Pterocaulon serrulatum (Montr.) Guillaumin var. *serrulatum* Asteraceae

1. Fresh leaves are boiled in water and the liquid used as an antiseptic wash for bad sores and cuts and for relief from itchy skin and ringworm.
   Ngurnungurnung (Ngarinyman) Aminbidji NMS 1138; **Ngurnungurnung** (Ngarinyman) Bulla NMS 733, NMS 1109; **?** (Rembarrnga) Gulin Gulin NMS 234.
2. Fresh leaves are rubbed in the hands and the vapours inhaled to clear blocked sinuses and for relief from head colds. A small plug of crushed leaves may be inserted in the nasal cavity and left for prolonged effect.
   ? (Jawony) Katherine NMS 371; **Mununyi** (Jingulu/Mudburra) Elliott NMS 974; **Junjarayi** (Wambiya) Elliott NMS 986.
3. Fresh leaves are boiled in water and the liquid used as a medicinal body wash for relief from bad colds, influenza and fever.
   Ngurnungurnung (Ngarinyman) Aminbidji NMS 1138; **Ngurnungurnung** (Ngarinyman) Bulla NMS 733, NMS 1109.
4. Fresh branches placed on a fire and allowed to smoulder will repell mosquitoes from the camp site.
5. Fresh leaves are soaked in water and when soft are rubbed all over the body to act as a very effective mosquito repellent.
   ? (Ngalkbun) Barunga NMS 546.

Pterocaulon sphacelatum (Labill.) Benth. & Hook. ex F. Muell. Asteraceae

1. Fresh leaves are boiled in water and the liquid is used as an eye wash to relieve sore and red eyes.
2. Fresh leaves are boiled in water and the liquid used as an antiseptic wash for sores of the skin and bad infected cuts.
3. Fresh leaves can be boiled in water and the vapours inhaled to give relief from colds and influenza.
   Pentye pentye (Eastern Aranda) Ltyentye Purte NMS 316.
4. Fresh leaves are crushed in the hand and the vapours inhaled to clear a blocked sinus and to provide relief from head colds and influenza. A small plug of crushed leaves may be inserted into the nasal cavity and left for prolonged effect.
   Manyanyi (Jingulu) Elliott.

Pycnoporus sanguineus (Fr.) Bond & Singer Polyporaceae

1. The fruiting body of the fungus can be chewed as a babies teething ring to help relieve sore gums.
2. The red dried mycelium can be patted onto sore, red, cracked lips and also on the inside of babies mouths as an effective cure for thrush.
   Tjaawalirpa (Pitjantjatjara) Kaltukatjara NMS 619.

Rhagodia eremaea Paul Wilson Chenopodiaceae

1. The bright red fruits can be squashed onto the face, beard and hair as a red dye. A little water may be added to help it spread. Possibly used for ceremonial decoration.
   Iriya (Yankunytjatjara) Ulpulla NMS 1367.

Rhizophora stylosa Griffith — Rhizophoraceae

1. Mudcrabs (*Scylla serrata*) are found at the base of this species.
   Murrutj (Batjamal), **Rungurr-rungurr** (Emi) Belyuen.

Rhyncharrhena linearis (Decne.) K.L. Wilson — Asclepiadaceae

1. The leaves can be eaten raw or lightly roasted like a vegetable.
2. When young, the long bean like fruits can be eaten raw or after roasting on hot coals. Older mature fruits can be eaten if the fibrous centres are first removed.
   Puya (Pitjantjatjara) Apatula NMS 1182; **Puya** (Yankunytjatjara) Ulpulla NMS 1373.

Salsola kali L. — Chenopodiaceae

1. The whole plant is boiled in water and the liquid is used as a medicinal wash to help reduce high temperatures.
   ? (Ngarinyman) Bulla NMS 1073.

Santalum acuminatum (R. Br.) DC. — Santalaceae

1. The fleshy exocarp of the fruit is eaten raw when ripe (red).
2. The fruits can be collected from the ground, cracked open and the kernel eaten raw or they can be ground into a moist paste which is cooked on hot coals like a damper or cake.
3. The kernels are smashed into a paste and applied directly to treat sore heads, headaches and scalp problems.
4. The old dried fruits are used by children as marbles.
5. People eagerly seek out these trees and most have their favourite trees which produce the sweetest fruits.
   Mangata=tree, **Tatu**=fruit (Yankunytjatjara) Ulpulla NMS 1363.

Santalum lanceolatum R. Br. — Santalaceae

1. Stems with the outer bark scraped away are boiled in water and the liquid drunk for relief from bad colds and coughs.
   Marluk (Rembarrnga) Gulin Gulin NMS 233.
2. Branches and leaves are placed over a pit of hot coals. A newborn baby is passed through the rising smoke to make it healthy and strong, and to ensure that the baby will sleep well. This is an important ritual in the management of infants that promotes health for the persons entire life. Children who are not treated run the risk of becoming seriously ill at any stage in their life. This important practice is still commonly carried out today.
   Dumuk (Jawony/Dalabon) Barunga NMS 336.
3. Fresh leaves are boiled in water and the liquid is used as a medicinal wash for relief from colds and influenza. The liquid can also be used to treat general illness of unknown causes. One man was bedridden for a very long time and after treatment with this medicine was up walking about very quickly. His sex life was also greatly enhanced.
   Mardunbuyunbul (Yanyula) Borroloola NMS 1241.
4. The fruit are eaten raw when ripe (purple): one person said this species had, in the past, been used as a medicine.
   ? (Ngarinyman) Bulla NMS 1112.

Sarcostemma australe R. Br. Asclepiadaceae

1. A handful of stems are soaked in hot water and the liquid is used as a medicinal wash to treat itchy skin, rashes and scabies. The language name for this species means breast milk, refering to the milky latex present in the stems.
   Ipi-ipi (Pitjantjatjara) Kaltukatjara NMS 618.

Sauropus glaucus (F. Muell.)Airy Shaw Euphorbiaceae

1. The elongated tubers are cleaned, pounded and boiled in water. The red liquid is used as an antiseptic wash for bad sores and cuts.
   ? (Kunwinjku) Maningrida NMS 626.

Scaevola taccada (Gaertner)Roxb. Goodeniaceae

1. The sap from young stems is squeezed directly onto bites, stings and rashes for pain relief.
   Yilyarra (Anindilyakwa) Angurugu NMS 210.
2. Young leaves are heated then placed directly over sore red eyes for pain relief.
   Midarrk, Midjarrk (Iwaidja) Minjilang NMS 155 & GMW.
3. One fruit is squeezed directly into the eye to clear sore red eyes and to cure eye infections.
   Yilyarra (Anindilyakwa) Angurugu NMS 219 ; **Midarrk, Midjarrk** (Iwaidja) Minjilang NMS 155 & GMW.

Semecarpus australiensis Engl. Anacardiaceae

1. The seeds are eaten after the fruits have been lightly roasted and the poisonous end section discarded. Contact with most parts of this species can cause blisters and welts.
   ? (Iwaidja) Minjilang GMW 3264 & NMS; **?** (Tiwi) Pularumpi NMS 1270.

**Senna alata* (L.) Roxb. Caesalpiniaceae

1. The leaves and stems are crushed between stones and rubbed over ringworm and fungal infections. This is not an Australian native species; it is used widely in tropical South America, where it is native, for the same purpose (Dennis 1988).
   ? (Batjamal/Emi) Belyuen NMS 1063; **?** (Gaalpu/Kunwinjku) Warruwi NMS 141 & GMW.

Senna artemisioides (DC.) Randell ssp. *filifolia* Randell Caesalpiniaceae

1. The seeds are eaten raw or they can be crushed and ground into flour to make small cakes which are roasted on hot coals.
2. This species is the favoured host of *Xyleutes* whose larvae 'witchetty grubs' develop in the roots of the shrub. The roots are dug up and the large grubs (up to 10cm long) are eaten raw or they can be lightly roasted on hot coals.
   Punti (Pitjantjatjara) Apatula NMS 1183.

Senna notabilis (F. Muell.) Randell Caesalpiniaceae

1. The branches and leaves are boiled in water and the liquid used as a medicinal wash to help reduce high fevers and as a treatment for ringworm.
   Kampijung (Ngarinyman) Bulla NMS 1072.

Senna venusta (F. Muell.) Randell Caesalpiniaceae

1. Young stems and leaves are crushed between stones and the liquid is rubbed directly onto the skin to relieve itchy skin and as a cure for ringworm.
   Warlanykari (Ngarinyman) Bulla NMS 747.

Smilax australis R. Br. Smilacaceae

1. The fruits are eaten raw when ripe (black).
   Dapu (Djambarrpuyngu) Milingimbi GMW 3400 & NMS.

Solanum centrale J. Black Solanaceae

1. The fruit is eaten raw when ripe (yellow/tan).
   Kumparrpa (Pitjantjatjara) Apatula NMS 1185.
2. The fruit of this form is considered inedible. Not poisonous but it may give you a slight headache.
   Artaring (Pitjantjatjara) Apatula NMS 1186.

Solanum ellipticum R. Br. Solanaceae

1. The fruits are eaten raw when ripe.
   Dulwarwarun, Wunki [wungki ?] (Pitjantjatjara) Apatula NMS 1168, NMS 1194.

Solanum quadriloculatum F. Muell. Solanaceae

1. The fruits of this species are considered to be very poisonous. If eaten they will cause 'liver' damage and death in 2-3 days.
   ? (Pitjantjatjara) Apatula NMS 1165, NMS 1198.
2. The fruit from this form is not considered to be poisonous although it is not eaten.
   Rungirungi (Pitjantjatjara) Apatula NMS 1184.

Sphaeranthus indicus L. Asteraceae

1. Fresh leaves and stems are boiled in water and the liquid is used as a medicinal body wash for relief from colds and influenza. A little of the liquid sipped will help clear the throat of phlegm and relieve any soreness.
2. Fresh leaves are crushed in the hands and the vapours inhaled to clear up any sinus trouble associated with colds and influenza. A plug of crushed leaves can be left inserted in the nasal cavity for prolonged effect.
   Manyanyi, Munjarjie (Jingulu/Mudburra) Elliott NMS 693.

Spinifex longifolius R. Br. Poaceae

1. Young fresh stems are crushed and boiled in water and the liquid is used as a medicinal wash for sores and cuts.
2. Young stems can be crushed and boiled in water and the liquid drunk for relief from internal pain. This medicine was recently used by one man as a replacement for morphine as it was considered to be more effective.
   Wurruwarduwarda (Anindilyakwa) Angurugu NMS 209.
3. The large round female flower heads are used by children as toys.
   ? (Burarra) Maningrida GMW ? & NMS.

Stenopetalum nutans F. Muell. Brassicaceae

1. The whole plant is eaten raw as a vegetable.
   Mangyura (Pitjantjatjara) Apatula NMS 1173.

Sterculia quadrifida R. Br. Sterculiaceae

1. The inner bark is used to make string or rope.
Balkpalk (Djambarrpuyngu) Milingimbi GMW 3490 & NMS; ? (Tiwi) Darwin NMS 115.
2. The inner bark is scraped into water and allowed to infuse. The liquid is strained and used as eye drops to relieve sore red eyes.
Balk-balk (Yolngu Matha) Yirrkala NMS 219.
3. Seeds are eaten raw when ripe (black), the black seed coat is peeled off or spat out; it is considered an excellent food and is often refered to as the 'bush peanut'.
Wu (Batjamal) Belyuen NMS 804; **Garrmurnamal**, **Gurrmurnamal** (Burarra) Maningrida GMW 3855 & NMS; **Wurwu** (Emi) Belyuen NMS 1031; **Balkpalk** (Djambarrpuyngu) Milingimbi; (Tiwi) Darwin NMS 115; **Balk-balk** (Yolngu Matha) Yirrkala NMS 219.

Streptoglossa bubakii (Domin) Dunlop Asteraceae

1. The whole plant can be boiled in water and the liquid used as a medicinal body wash for relief from colds and influenza. The mixture can be stored for up to one week for later use.
2. The leaves can be crushed in the hand and the vapours inhaled to help relieve sinus trouble associated with head colds. A plug of crushed leaves can be inserted and left in the nasal cavity for prolonged effect.
Mununyi, **Munjarjie** (Mudburra) Elliott NMS 696, NMS 697; **Manyanyi** (Mudburra/Ngarinyman) Bulla NMS 1107.

Streptoglossa odora (F. Muell.) Dunlop Asteraceae

1. The whole plant is boiled in water until the liquid turns green. The liquid is used as a medicinal body wash for relief from colds and influenza. The mixture can be stored for later use when warm water can be added to heat it up.
Manyanyi (Mudburra/Ngarinyman) Bulla NMS 940, NMS 1113.

Strychnos lucida R. Br. Loganiaceae

1. The leaves and fruits are thrown onto the surface of freshwater holes as a fish poison. The fish rise to the surface dead; only the flesh is eaten. The Burarra language name is the same as is used for a snail.
Ngarlagurla (Burarra) Maningrida GMW 3860 & NMS; **Nyamiyarla** (Iwaidja) Minjilang; ? (Gaalpu/Kunwinjku) Warruwi NMS 138 & GMW.
2. The white pulp in the fruit is applied directly onto the skin as a treatment for scabies. It can also be used to help dry weeping sores and cuts.
Yeweyi (Ngankikurungkurr) Nauiyu Nambiyu NMS 620, NMS 1023.

Syzygium armstrongii (Benth.) B. Hyland Myrtaceae

1. The fruits are eaten raw when ripe (white).
Den (Emi) Belyuen GMW ? & NMS.

Syzygium eucalyptoides (F. Muell.) B. Hyland ssp. *bleeseri* (O. Schwarz)B. Hyland Myrtaceae

1. The fruit is eaten raw when ripe (white or pale pink).
Bermbetjek (Batjamal) Belyuen GMW 4512 & NMS; **Morlanggi** (Burarra) Maningrida GMW 5095; **Werner** (Emi) Belyuen NMS 843; **Pinyama** (Tiwi) Darwin.

Syzygium suborbiculare (Benth.) Hartley & Perry Myrtaceae

1. The inner wood from the stems is boiled in water and the liquid used as an eye wash to relieve tired, sore eyes.
   Narrani (Djambarrpuyngu) Galiwinku NMS 163.
2. The fruit is eaten raw when ripe (red).
   Ngukjirrga, Ngukurarrkurarrk (Burarra) Maningrida GMW 3853 & NMS; **Winga** (Batjamal), **Wumbirri** (Emi) Belyuen NMS 805; **Narrani** (Djambarrpuyngu) Galiwinku NMS 163; **Narrani** (Djambarrpuyngu) Milingimbi NMS 510 & GMW.
3. The flesh of the fruit and some of the inner seed can be chewed to relieve toothache.
   Narrani (Djambarrpuyngu) Galiwinku NMS 163; **Narrani** (Djambarrpuyngu) Milingimbi NMS 510 & GMW.

Tacca leontopetaloides (L.) Kuntze Taccaceae

1. The tuber is eaten only after thorough cooking; for example at Belyuen it is only eaten after it has been cooked in the coals of *Acacia auriculiformis* for at least 24 hours.
   Kelmerre (Batjamal), **Ngalkurr** (Emi) Belyuen NMS 877; **Nguthumu** (Djambarrpuyngu) Milingimbi GMW 3446 & NMS; **?** (Malak-Malak) Wooliana area NMS 442.
2. The tuber is considered poisonous and is not eaten.
   ? (Ngarinyman) Bulla NMS 943; **?** (Ngalkbun) Barunga NMS 345.
3. The rolled or incurved edges of the stems are brushed up against the faces of boys at puberty to stop the onset of growth of new wiskers (hairs).
4. The stems are blown to produce a whistle sound; a favourite childrens toy.
   ? (Ngarinyman) Bulla NMS 943.
5. The fruits are eaten raw when ripe; the seeds can be eaten or spat out according to personal taste.
   Kelmerre (Batjamal) **Ngalkurr** (Emi) Belyuen NMS 1052; **Nguthumu** (Djambarrpuyngu) Milingimbi GMW 3446 & NMS; **Mimi-mudi** (Ngankikurungkurr) Nauiyu Nambiyu area NMS 442; **?** (Ngarinyman) Bulla NMS 943.

******Tamarindus indica*** L. Caesalpiniaceae

1. The fruits are considered edible. The pulp around the seeds is squeezed out and soaked in a cup of water. The mixture can be sweetened with sugar if desired. It makes a refreshing drink which can also be used as a good pick-me-up after one has been suffering from a cold. This species is considered to be introduced by the Macassans (Macknight 1976).
   Djambang (Djambarrpuyngu) Milingimbi NMS 716 & GMW.
2. The pulp in the fruit is eaten raw when ripe (soft and brown).
   ? (Batjamal/Emi) Belyuen NMS 1044.

Tephrosia polyzyga F. Muell. ex Benth. Fabaceae

1. The whole plant is placed on the surface of a freshwater hole to poison fish. The 'stunned' fish rise to the surface and can be easily collected.
   Muyungu (Djambarrpuyngu) Milingimbi GMW 3416 & NMS.

Tephrosia phaeosperma F. Muell. ex Benth. Fabaceae

1. The branches and leaves are broken up and spread out over a freshwater hole to 'poison' fish. The 'stunned' fish rise to the surface and can be easily collected. Works especially well for black bream.
   ? (Ngarinyman) Aminbidji, Bulla 1139.

Tephrosia porrecta R.Br. ex Benth. Fabaceae

1. The tubers are peeled, crushed and boiled in water. The yellow liquid is used as an antiseptic wash for sores and cuts. Use once a day till cured.
   ? (Kunwinjku) Maningrida NMS 632.

Terminalia arostrata Ewart & O.B. Davies Combretaceae

1. Fresh leaves and a few branches are boiled in water and the liquid used as a medicinal wash to treat boils and to help reduce a high temperature associated with fever. The liquid is not drunk.
2. The seeds are eaten raw; the fruits are collected from the ground and cracked open between stones.
   Partiki (Ngarinyman) Bulla NMS 900, NMS 949, NMS 1105.

Terminalia canescens (DC.) Radlk. Combretaceae

1. This species exudes a clear gum that is eaten like a sweet.
   ? (Ngarinyman) Bulla NMS 919.

Terminalia grandiflora Benth. Combretaceae

1. The fruits are cracked open and the seeds are eaten raw; mostly they are collected from the ground.
   D̲eti (Djambarrpuyngu) Milingimbi GMW 3504 & NMS; ? (Ngalkbun) Gulin Gulin.

Terminalia hadleyana W. Fitzg. ssp. *carpentariae* (C. White) Pedley Combretaceae
(*T. carpentariae*)

1. The red sticky inner bark can be applied directly onto the skin to treat sores, leprosy and to relieve itchy skin.
   Mupan (Djambarrpuyngu) Galiwinku NMS 172, NMS 585; **Mapud̲umun** (Djambarrpuyngu) Milingimbi NMS 501 & GMW; **Mamanbu** (Yolngu M̄atha) Yirrkala NMS 183.
2. The red sticky inner bark can be spread directly onto the skin or after pounding and moistening with a little water rubbed over the body to tighten up any loose skin, to make a weak person fit and healthy again and to treat anaemia.
   Mardangich (Burarra) Maningida NMS 642 & GMW; **Mupan** (Djambarrpuyngu) Galiwinku NMS 172, NMS 585; **Mapud̲umun** (Djambarrpuyngu) Ramingining NMS 655 & GMW.
3. The red inner bark is used as a cement or glue for plugging holes in canoes, cracks in dijeridoo's or bark paintings.
   Mupan (Djambarrpuyngu) Galiwinku NMS 172, NMS 585; **Mapud̲uman** (Djambarrpuyngu) Ramingining NMS 655 & GMW; **Mamanbu** (Yolngu M̄atha) Yirrkala NMS 183.
4. The fruit is eaten raw when ripe (yellow); considered to be very sweet and is highly sought after.
   Mamaburra (Anindilyakwa) Angurugu; **Mardangich** (Burarra) Maningrida NMS 642 & GMW; **Mupan** (Djambarrpuyngu) Galiwinku NMS 172, NMS 585; **Mapud̲umun** (Djambarrpuyngu) Milingimbi NMS 501 & GMW; **Mapuduman** (Djambarrp̄uyngu) Ramingining NMS 655 & GMW; **Mamanbu** (Yolngu Mathā) Yirrkala NMS 183.

Terminalia latipes Benth. Combretaceae
(***T. ferdinandiana***)
1. The leaves are heated on hot coals then used as a poultice for sore eyes that are swollen as a result of a blow or infection.
   Mardangich (Burarra) Maningrida NMS 518.
2. The fruits are eaten raw when ripe (pale green), generally they are collected from the ground.
   Menangbere (Batjamal), **Menthem** (Emi) Belyuen NMS 802, NMS 1025; **Mardangich** (Burarra) Maningrida NMS 518; **Wardabidj** (Dalabon) Barunga NMS 350; **Ngän'kabakarra** (Djambarrpuyngu) Galiwinku; **Ngän'kabakarra** (Djambarrpuyngu) Milingimbi GMW 3329 & NMS; ? (Jawony) Katherine NMS 377; ? (Murrinh-Patha) Wadeye NMS 495; ? (Ngankikurungkurr) Nauiyu Nambiyu NMS 460; ? (Tiwi) Pularumpi.
3. When injured this species exudes an edible gum that is sucked as a sweet.
   ? (Tiwi) Darwin NMS 1306.

Terminalia oblongata F. Muell. ssp. ***volucris*** (R. Br. ex Benth.) Pedley Combretaceae
(***T. volucris***)
1. No use recorded.
   Lankujbi (Jingulu) Elliott NMS 963.

Terminalia platyphylla F. Muell. Combretaceae
1. The fruits are eaten by black cockatoos.
2. This species exudes an edible clear gum that is sucked like a sweet.
   Marntayang (Ngarinyman) Bulla NMS 758, NMS 929.

Terminalia pterocarya F. Muell. Combretaceae
1. This species exudes an edible clear gum that is eaten like a sweet.
   ? (Yanyula) Borroloola NMS 1264.

Themeda arguens (L.) Hackel Poaceae
1. The spikelets are used by children to spear flies on wounds.
   ? (Djambarrpuyngu) Milingimbi GMW 3508 & NMS.

Themeda avenacea (F. Muell.) Maiden & Betche Poaceae
1. The whole plant is pounded, boiled in water and the liquid used as a medicinal body wash to relieve the symptoms of colds, influenza and fever.
2. Fresh leaves and stems are rubbed all over the body to help relieve the symptoms of colds and influenza.
   Ilintji (Pitjantjatjara) Apatula NMS 1207; **Ilintji** (Pitjantjatjara) Kaltukatjara NMS 613.
3. The whole plant is smashed and thrown onto the surface of fresh water holes to clean up dirty water and make it drinkable.
4. Children make spears from the culms.
   Ilintji (Pitjantjatjara) Apatula NMS 1207.

Thespesia populneoides (Roxb.) Kostel Malvaceae
1. The stems and branches are used to make spears.
   Meli (Djambarrpuyngu) Milingimbi GMW 3502 & NMS.

Thryptomene maisonneuvei F. Muell. Myrtaceae

1. Early in the morning the flowering branches are flicked down onto collecting dishes to gather the nectar. It can be licked directly from the dishes or mixed with water and made into a sweet drink. Locally called the honey tree.
   Pukara (Yankunytjatjara) Ulpulla NMS 1375.

Thysanotus exiliflorus F. Muell. Liliaceae

1. In really hot weather the moisture laiden tubers are crushed over the body to help cool down the skin. They can also be eaten to quench the thirst when no surface water is available to drink.
   Walpa walpa (Pitjantjatjara/Yankunytjatjara) Apatula NMS 1206.

Tinospora smilacina Benth. Menispermaceae

1. The root is considered to be very poisonous.
   Burrpu (Djambarrpuyngu) Milingimbi GMW 3444 & NMS; **?** (Ngalkbun) Barunga NMS 344.
2. The root is cleaned, smashed then boiled in water. The liquid is used as a medicinal wash to help draw out blind boils. The skin is washed as often as required.
   Jalardu (Ngarinyman) Bulla NMS 904.
3. The stems are pounded and flattened to make a strong string or rope. In recent times the young stems have been used to make a colourful binding on the end of a stock whip handle.
   Yarungkurrmi (Jingulu), **Jalardu** (Mudburra) NMS 686; **Jalardu** (Ngarinyman) Bulla NMS 737.
4. The leaves are heated on hot coals then placed directly over sores, cuts and boils, (often they are left for a few days under a firm bandage). The treatment will relieve any pain, clear up infection and draw out any blind boils.
   ? (Gaalpu/Kunwinjku) Warruwi NMS 132 & GMW; **Kurtawurak** (Iwaidja) Minjilang NMS 144 & GMW; **Jalardu** (Ngarinyman) Bulla NMS 904.
5. Heated leaves are placed over the forehead to relieve headaches. They can be held on with a section of stem tied around the head. Replace as pain returns.
   ? (Gaalpu/Kunwinjku) Warruwi NMS 132 & GMW.
6. The fruits are considered to be very poisonous.
   Burrpu (Djambarrpuyngu) Milingimbi GMW ? & NMS; **Jalardu** (Ngarinyman) Bulla NMS 737.

Trachymene glaucifolia (F. Muell.) Benth. Apiaceae

1. The stems are eaten raw when young and crisp.
   Mai=vegetable food (Pitjantjatjara) Apatula NMS 1169.

Trema tomentosa (Roxb.) Hara Ulmaceae

1. Possibly the leaves are used medicinally to help draw out boils.
   Murrtjumun (Djambarrpuyngu) Galiwinku NMS 160.
2. No use recorded.
   Midjirripiya (Batjamal/Emi) Belyuen GMW 4530 & NMS.

Triodia pungens R. Br. Poaceae

1. The whole plant is crushed in a coolamon with an axe or stone, mixing with a little termitaria (the clay casing of termite nests) and a little water. The coolamon is placed over a bed of hot coals whilst crushing. The dark coloured liquid is then poured off and

drunk by the mother and newborn baby as a health promoter. This is carried out as soon as possible after child birth to ensure that the child will grow up to be healthy and strong. It also helps in the mothers recovery after the trauma of childbirth.
2. The whole plant is boiled in water and the liquid used as a medicinal body wash for relief from colds and influenza.
3. The grass burned on the fire will repell mosquitoes from around the camp site.
Munuk=grass, **Marta**=termitaria (Ngarinyman) Bulla NMS 1095.

Triodia sp. Poaceae
1. A good handful of leaves are boiled in half a billy can of water and the liquid used as a medicinal wash for any skin disorders such as itchy skin. Use as often as required.
2. The flowers (pollen) from this species is said to make honey "cheeky" (hot tasting) and inedible.
Milulami ? (Tiwi) Nguiu GMW 3570 & NMS.

Triodia stenostachya Domin Poaceae
1. The whole plant can be boiled in water and the liquid used as a body wash for relief from bad colds and influenza.
2. The resin on the leaves is melted over hot coals, collected into a ball and used as a bonding agent or cement, i.e. for holding hooks on spears. Not used nowadays.
Munuk (Ngarinyman) Bulla.

Typhonium alismifolium F. Muell. Araceae
1. The tuber is eaten after it has been roasted on hot coals and pounded.
? (Djambarrpuyngu) Milingimbi GMW 3402 & NMS.

Typhonium angustilobum F. Muell. Araceae
1. The tuber is eaten after roasting on hot coals.
? (Djambarrpuyngu) Milingimbi GMW 3403 & NMS.

Typhonium liliifolium Schott. Araceae
1. The tuber is edible only after it has been repeatedly smashed and cooked at least three times. Eaten raw or undercooked it will 'burn your mouth out'.
? (Ngarinyman) Bulla NMS 944.

Vitex glabrata R. Br. Verbenaceae
1. The fruits are eaten raw when ripe (black), often after they have fallen to the ground. In many areas emu eat the fruit of this species.
Merra (Batjamal), **Perme** (Emi) Belyuen NMS 807; **Wambajarr** (Burarra) Maningrida GMW 5092 & NMS; **Woyal** (Jawony) Katherine NMS 376, NMS 881; **Marralun**[g?] (Ngarinyman) Bulla NMS 735.

*****Vitex*** sp. Verbenaceae
1. The leaves are crushed and soaked in water. The liquid is used as a medicinal wash for the treatment of scabies and other skin conditions. This is not a native species. Its use on Milingimbi Island was introduced by some visitors from Fiji, possibly in the 1960's. (Pers. comm. Yanayana)
? (Djambarrpuyngu) Milingimbi NMS 1068 & GMW.

Wurmbea deserticola T. Macfarlane Liliaceae

1. A plant with 'pretty flowers'. Possibly the bulbs are or have in the past been eaten?.
   Walpa walpa (Pitjantjatjara) Apatula NMS 1193.

Ziziphus quadrilocularis F. Muell. Rhamnaceae

1. Fresh leaves are boiled in water and the liquid drunk as a cure for diarrhoea.
2. A few old dried fruits collected from the ground and eaten will cure bad cases of diarrhoea.
3. The fruits are eaten raw when ripe (red).
   Maturrku (Ngarinyman) Aminbidji NMS 1144; **Maturrku, ?Gulik gulik** (Ngarinyman) Bulla NMS 905.

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APPENDIX 1: Plant species used as medicinal agents

Ear, Eye, Nose ailments; *Acacia multisiliqua, Agave* sp., *Asteromyrtus symphyocarpa, Clerodendrum floribundum, Cymbopogon bombycinus, Cymbopogon procerus, Dolichandrone heterophylla, Eremophila duttonii, Eremophila sturtii, Eucalyptus opaca, Grewia retusifolia, Melaleuca acacioides, Melaleuca leucadendra, Melaleuca viridiflora, Pandanus spiralis, Persoonia falcata, Pterocaulon globuliflorus, Pterocaulon serrulatum* var. *serrulatum, Pterocaulon sphacelatum, Scaevola taccada, Sphaeranthus indicus, Sterculia quadrifida, Streptoglossa bubakii, Syzygium suborbiculare, Terminalia latipes.*

Pain producing ailments (i.e. sore back and joints); *Acacia lysiphloia, Alphitonia excelsa, Capparis umbonata, Clerodendrum floribundum, Codonocarpus cotinifolius, Crinum angustifolium, Crotalaria eremaea* var. *strehlowii, Croton arnhemicus, Cymbopogon bombycinus, Cyperus victoriensis, Eremophila bignoniiflora, Eremophila*

latrobei var. *labrobei, Erythrophleum chlorostachys, Eucalyptus camaldulensis, Eucalyptus microtheca, Excoecaria parvifolia, Ipomoea pes-caprae* ssp. *brasiliensis, Melaleuca leucadendra, Melaleuca viridiflora, Pandanus spiralis, Spinifex longifolius, Tinospora smilacina.*

Respiratory ailments (i.e. bronchitus, coughs, sore throat & asthma); *Acacia oncinocarpa, Amyema bifurcatum, Asteromyrtus symphyocarpa, Clerodendrum floribundum, Cymbopogon bombycinus, Cymbopogon obtectus, Eremophila alternifolia, Eremophila freelingii, Eremophila latrobei* var. *glabra, Eucalyptus camaldulensis, Eucalyptus miniata, Eucalyptus terminalis, Eucalyptus tetrodonta, Ipomoea pes-caprae* ssp. *brasiliensis, Isotoma petraea, Livistona humilis, Melaleuca acacioides, Melaleuca cajuputi, Melaleuca leucadendra, Morinda citrifolia, Pandanus spiralis, Passiflora foetida, Persoonia falcata, Prostanthera striatiflora, Santalum lanceolatum, Sphaeranthus indicus.*

Gastro-intestinal ailments (i.e. stomach ache, diarrhoea); *Adansonia gregorii, Callitris intratropica, Clerodendrum floribundum, Cymbopogon refractus, Eucalyptus tectifica, Ficus opposita, Ficus platypoda* var. *minor, Flagellaria indica, Grewia retusifolia, Jacksonia dilatata, Litsea glutinosa, Nymphaea macrosperma, Nymphaea* sp., *Nymphoides indica, Pandanus spiralis, Ziziphus quadrilocularis.*

Skin complaints (i.e. sores, wounds, rashes, burns & leprosy); *Acacia estrophiolata, Acacia holosericea, Acacia pellita, Acacia tetragonophylla, Alphitonia excelsa, Avicennia marina, Brachychiton diversifolius, Buchanania obovata, Camptostemon schultzii, Capparis umbonata, Celtis philippensis, Clerodendrum floribundum, Cochlospermum fraseri* ssp. *heteronemum, Codonocarpus cotinifolius, Crinum angustifolium, Croton arnhemicus, Cymbidium canaliculatum, Cymbopogon procerus, Dendrobium affine, Dendrobium canaliculatum, Dicrostachys spicata, Diospyros maritima, Dolichandrone heterophylla, Eremophila duttonii, Eremophila freelingii, Eremophila longifolia, Eremophila sturtii, Erythrophleum chlorostachys, Eucalyptus bleeseri, Eucalyptus miniata, Eucalyptus opaca, Eucalyptus terminalis, Eucalyptus tetrodonta, Euphorbia hirta, Euphorbia tannensis, Excoecaria parvifolia, Ficus coronulata, Flueggea virosa* ssp. *melanthesoides, Gardenia megasperma, Gardenia* sp., *Grevillea heliosperma, Grewia orientalis, Grewia retusifolia, Gyrocarpus americanus, Hakea arborescens, Hakea divaricata, Hakea eryeana, Hakea macrocarpa, Hakea suberea, Hibiscus tiliaceus, Ipomoea pes-caprae* ssp. *brasiliensis, Lysiphyllum cunninghamii, Melaleuca viridiflora, Mnesithea rottboellioides, Owenia vernicosa, Pandanus spiralis, Passiflora foetida, Petalostigma quadriloculare, Philydrum lanuginosum, Planchonia careya, Pleomele angustifolia, Protasparagus racemosus, Pterocaulon globuliflorus, Pterocaulon serrulatum* var. *serrulatum, Pterocaulon sphacelatum, Pycnoporus sanguineus, Santalum acuminatum, Sarcostemma australe, Sauropus glaucus, Scaevola sericea, Senna alata, Senna notabilis, Senna venusta, Spinifex longifolius, Strychnos lucida, Tephrosia porrecta, Terminalia arostrata, Terminalia hadleyana* ssp. *carpentariae, Tinospora smilacina, Trema tomentosa, Triodia* sp., *Vitex* sp.

Febrile complaints (i.e. colds, fever and influenza); *Acacia lysiphloia, Acacia multisiliqua, Acacia spondylophylla, Amyema bifurcatum, Asteromyrtus symphyocarpa, Brachychiton diversifolius, Calytrix brownii, Carissa lanceolata, Clerodendrum floribundum, Cochlospermum fraseri* ssp. *heteronemum, Codonocarpus cotinifolius, Crotalaria eremaea* var. *strehlowii, Cymbopogon bombycinus, Cymbopogon obtectus, Cymbopogon procerus, Dodonaea physocarpa, Dodonaea polyzyga, Eremophila alternifolia, Eremophila bignoniiflora, Eremophila duttonii, Eremophila freelingii, Eremophila latrobei* var. *glabra, Eremophila latrobei* var. *latrobei, Eremophila sturtii, Eucalyptus camaldulensis, Eucalyptus dichromophloia, Eucalyptus microtheca, Eucalyptus miniata, Eucalyptus pruinosa, Eucalyptus terminalis, Eucalyptus tetrodonta, Exocarpos latifolius, Flagellaria indica, Grewia retusifolia, Halgania glabra, Ipomoea pes-caprae* ssp. *brasiliensis, Limnophila* sp. *Lysiphyllum cunninghamii, Melaleuca acacioides, Melaleuca argentea, Melaleuca cajuputi, Melaleuca leucadendra, Melaleuca stenostachya, Melaleuca viridiflora, Morinda citrifolia, Prostanthera striatiflora, Pterocaulon globuliflorus, Pterocaulon serrulatum* var. *serrulatum, Pterocaulon sphacelatum, Salsola kali, Santalum lanceolatum, Senna notabilis, Sphaeranthus indicus, Sterculia quadrifida, Streptoglossa bubakii, Streptoglossa odora, Tamarindus indica, Terminalia arostrata, Themeda avenacea, Triodia pungens, Triodia stenostachya.*

Fractures and sprains; *Acacia tetragonophylla, Callitris intratropica, Clerodendrum floribundum, Cochlospermum fraseri* spp. *heteronemum, Croton arnhemicus, Excoecaria parvifolia, Protasparagus racemosus, Terminalia latipes.*

Debility ailments (i.e. general weakness, anemia, immobility); *Camptostemon schultzii, Eucalyptus pruinosa, Terminalia hadleyana* ssp. *carpentariae.*

Toothache; *Buchanania obovata, Carissa lanceolata, Osbornia octodonta, Syzgium suborbiculare.*

Ichthiocides; *Acacia auriculiformis, Acacia holosericea, Atalaya hemiglauca, Barringtonia acutangula, Owenia vernicosa, Planchonia caryea, Strychnos lucida, Tephrosia polyzyga, Tephrosia phaeosperma.*

New born & infant managment; *Acacia lysiphloia, Aegiceras corniculata, Cymbopogon bombycinus, Eulalia aurea, Exocarpos latifolius, Santalum lanceolatum, Triodia pungens.*

Gynaecological remedies (i.e. sterility, milk letdown, thrush etc.); *Cymbopogon bombycinus, Dendrobium affine, Dendrobium canniculatum, Erythrophleum chlorostachys, Eucalyptus tectifica.*

Ritual (i.e. house cleaning); *Erythrophleum chlorostachys.*

Insecticides; *Banksia dentata, Calytrix exstipulata, Eremophila duttonii, Pterocaulon serrulatum* var. *serrulatum, Triodia pungens.*

Ailments of unknown causes; *Amorphophallus paeoniifolius, Brachychiton diversifolius, Eremophila alternifolia, Eucalyptus pruinosa, Lepidium phlebopetalum, Lysiphyllum cunninghamii, Melaleuca argentea, Melaleuca stenostachya, Melaleuca viridiflora, Santalum lanceolatum.*

Tobacco & additives; *Acacia auriculiformis, Eucalyptus camaldulensis, Eucalyptus clavigera, Eucalyptus confertiflora, Eucalyptus microtheca, Hyptis suaveolens, Isotoma petraea, Lobelia quandrangularis, Nicotiana occidentalis.*

Other (illness not categorised); *Acacia estrophiolata, Casuarina equisetifolia, Cleome viscosa, Gyrocarpos americanus, Hakea subera, Leptospermum parviflorum, Pycnoporus sanguineus, Santalum lanceolatum, Thysanotus exiliflorus.*

APPENDIX 2: Species utilized as foods

Vegetables (yams, cabbages etc.): *Amorphophallus galbra, Arenga australasica, Blennodia canescens, Boerhavia coccinea, Brassica tournefortii, Carpentaria acuminata, Cayratia trifolia, Choiromyces aboriginus, Clerodendrum floribundum, Cochlospermum fraseri* ssp. *heteronemum, Convolvulus erubescens, Corypha elata, Cyperus bulbosus, Dioscorea bulbifera, Dioscorea transversa, Eriosema chinense, Hypoxis nervosa, Ipomoea abrupta, Ipomoea graminea, Ipomoea pes-caprae* ssp. *brasiliensis, Ipomoea racemigera, Livistona humilis, Livistona* sp., *Mnesithea rottboellioides, Nymphaea gigantea, Nymphaea macrosperma, Nymphaea violacea, Operculina aequisepela, Pandanus spiralis, Portulaca oleracea, Portulaca pilosa, Rhyncharrhena linearis, Stenopetalum nutans, Tacca leontopetaloides, Thysanotus exiliflorus, Trachymene glaucifolia, Typhonium alismifolium, Typhonium angustilobum, Typhonium liliifolium.*

Flowers & nectar: *Eremophila latrobei* var. *glabra, Eremophila latrobei* var. *latrobei, Grevillea juncifolia, Grevillea pteridifolia, Grevillea striata, Hakea divaricata, Hakea eryeana, Hakea suberea, Lysiphyllum cunninghamii, Thryptomene maisonneuvei.*

Gum: *Acacia estrophiolata, Brachychiton diversifolius, Erythroxylum ellipticum, Terminalia canescens, Terminalia latipes, Terminalia platyphylla, Terminalia pterocarya.*

Culinary herbs: *Asteromyrtus symphyocarpa, Corynotheca lateriflora, Eremophila longifolia, Eucalyptus camaldulensis, Grevillea pteridifolia, Lepidium phlebopetalum.*

Thirst quenchers & sugar canes: *Brachychiton diversifolius, Cochlospermum fraseri* ssp. *heteronemum, Heteropogon triticeus, Melaleuca nervosa, Melaleuca viridiflora, Mnesithea rottboellioides, Thysanotus exiliflorus.*

Grubs in root or fruit: *Acacia kempeana, Acacia victoriae, Codonocarpus cotinifolius, Eucalyptus microtheca, Eucalyptus opaca, Senna artemisoides* ssp. *filifolia.*

Fruits: *Adansonia gregorii, Ampelocissus acetosa, Ampelocissus frutescens, Amyema maidenii* ssp. *maidenii, Antidesma ghaesembilla, Avicennia marina, Buchanania obovata, Canthium latifolium, Capparis lasiantha, Capparis umbonata, Carallia brachiata, Carissa lanceolata, Cassytha filiformis, Cayratia trifolia, Cucumis melo, Cynanchum pedunculatum, Drypetes lasiogyna, Enchylaena tomentosa, Erythroxylum ellipticum, Exocarpos latifolius, Ficus coronulata, Ficus opposita, Ficus platypoda, Ficus platypoda* var. *lachnocaula, Ficus platypoda* var. *minor, Ficus platypoda* var. *platypoda, Ficus racemosa, Ficus scobina, Ficus virens, Flacourtia territorialis, Flueggea virosa* ssp. *melanthesoides, Grewia multiflora, Grewia orientalis, Grewia retusifolia, Grewia* sp., *Grewia* sp. *(CRD 6477), Leea rubra, Lysiana subfalcata, Marsdenia australis, Momordica balsamina, Morinda citrifolia, Nauclea orientalis, Nelumbo nucifera, Nymphaea gigantea, Nymphaea macrosperma, Opilia amentacea, Pandanus spiralis, Paramignya trimera, Passiflora foetida, Persoonia falcata, Physalis minima, Planchonia careya, Rhyncharrhena linearis, Santalum acuminatum, Santalum lanceolatum, Smilax australis, Solanum centrale, Solanum ellipticum, Syzygium armstrongii, Syzygium eucalyptoides* ssp. *bleeseri, Syzygium suborbiculare, Tacca leontopetaloides, Tamarindus indica, Terminalia hadleyana* ssp. *carpentariae, Terminalia latipes, Vitex glabrata, Ziziphus quadrilocularis.*

Seeds: *Acacia holosericea, Acacia tetragonophylla, Brachychiton diversifolius, Brachychiton megaphyllus, Brachychiton* sp., *Canarium australianum, Cycas angulata, Cycas armstrongii, Eragrostis eriopoda, Eragrostis laniflora, Nymphaea gigantea, Nymphaea macrosperma, Pandanus spiralis, Portulaca oleracea, Santalum acuminatum, Semecarpus australiensis, Senna artemisoides* ssp. *filifolia, Sterculia quadrifida, Tacca leontopetaloides, Terminalia arostrata, Terminalia grandiflora.*

APPENDIX 3: Species used in material culture

Wooden implements & weapons: *Acacia aneura* var. *aneura, Acacia holosericea, Adansonia gregorii, Aegicerus corniculatum, Bambusa arnhemica, Bombax ceiba, Bruguiera gymnorrhiza, Carallia brachiata, Chionachne cyathopoda, Cymbopogon procerus, Dolichandrone heterophylla, Ehretia saligna, Erythrophleum chlorostachys, Excoecaria parvifolia, Grewia* sp., *Gyrocarpus americanus, Heteropogon triticeus, Hyptis suaveolens, Litsea glutinosa, Lophostemon lactifluus, Lumnitzera littorea, Macaranga tanarius, Macropteranthes kekwickii, Pandorea doratoxylon, Themeda avenacea, Thespesia populneoides.*

Artefacts (bark painting & carvings etc.): *Adansonia gregorii, Bombax ceiba, Eucalyptus tetrodonta, Gyrocarpus americanus, Hibiscus tiliaceus, Melaleuca leucadendra, Melaleuca minutifolia.*

Canoes: *Alstonia actinophylla, Bombax ceiba, Camptostemon schultzii, Canarium australianum, Gyrocarpus americanus, Maranthes corymbosa.*

Building materials: *Erythrophleum chlorostachys, Eucalyptus papuana, Melaleuca argentea, Melaleuca viridiflora.*

String/cordage/basket weaving: *Agave sisalana, Antiaris toxicaria, Brachychiton diversifolius, Brachychiton spectabilis, Brachychiton* sp., *Cyperus javanicus, Ficus virens, Helicteres elongata, Hibiscus tiliaceus, Marsdenia velutina, Pandanus spiralis, Sterculia quadrifida, Tinospora smilacina.*

Dyes: *Cassytha filiformis, Eucalyptus confertiflora, Eucalyptus papuana, Haemodorum coccineum, Haemodorum* sp., *Hakea eryeana, Livistona humilis, Morinda citrifolia, Pandanus spiralis, Pogonolobus reticulatus, Rhagodia eremaea.*

General ceremonial use: *Capparis umbonata, Flagellaria indica, Grevillea dimidiata, Hakea eryeana, Hanguana malayana, Nelumbo nucifera, Rhagodia eremaea.*

Ornamentation: *Abrus precatorius, Canavalia rosea, Crotalaria goreensis, Flagellaria indica, Grevillea dimidiata, Planchonia careya.*

Glues, gum, adhesives: *Acacia aneura* var. *latifolia, Cymbidium canaliculatum, Dendrobium affine, Dendrobium canaliculatum, Grewia retusifolia, Terminalia hadleyana* ssp. *carpentariae, Triodia stenostachya.*

Sandpaper: *Ficus opposita, Ficus scobina.*

Childrens toys: *Calophyllum inophyllum, Corypha elata, Cymbopogon procerus, Gyrocarpus americanus, Eucalyptus terminalis, Heteropogon triticerus, Hyptis sauveolens, Mnesithea rottboellioides, Pelatostigma pubescens, Santalum acuminatum, Spinifex longifolius, Themeda arguens, Themeda avenacea.*

Fire wood/fire sticks/fire starters: *Acacia aneura* var. *aneura, Acacia auriculiformis, Banksia dentata, Erythrophleum chlorostachys, Leea rubra, Macropteranthes kekwickii, Premna acuminata, Premna serratifolia, Protasparagus racemosus.*

Other (various uses): *Aegialitis annulata, Alloteropsis semialata, Avicennia marina, Bombax ceiba, Cochlospermum fraseri* ssp. *heteronemum, Duboisia hopwoodii, Gossypium hirsutum, Hibiscus tiliaceus, Livistona* sp., *Melaleuca viridiflora, Melastoma affine, Nymphaea gigantea, Tacca leontopetaloides, Themeda avenacea.*

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HISTORICAL ASPECTS OF THE ORIGIN AND DISTRIBUTION OF TAGASASTE (*CHAMAECYTISUS PROLIFERUS* (L. FIL.)LINK SSP. *PALMENSIS* (CHRIST)KUNKEL), A FODDER TREE FROM THE CANARY ISLANDS

J. Francisco-Ortega & M.T. Jackson

Plant Genetics Group, School of Biological Sciences, University of Birmingham, Edgbaston, Birmingham, B15 2TT, United Kingdom

and

A. Santos-Guerra & M. Fernández-Galván

Jardín de Aclimatación de La Orotava, Puerto de La Cruz, Tenerife, Canary Islands, Spain

Abstract

Chamaecytisus proliferus (L. fil.)Link (Fabaceae: Genisteae) forms a taxonomic complex which is endemic to El Hierro, La Palma, La Gomera, Tenerife and Gran Canaria in the Canary Island archipelago. Forms from La Palma are popularly known as "tagasaste" whereas those from the rest of the archipelago are commonly called "escobón". Tagasaste is the only form which is broadly cultivated in the Canary Islands, and since the late 19th century in New Zealand and Australia. It has also become naturalized in Australia (South Australia, New South Wales, Victoria and Tasmania), Java, the Hawaiian Islands, California, Portugal, North Africa, Kenya, Tanzania and South Africa. Dr Victor Pérez, a medical practitioner from La Palma, introduced tagasaste as a fodder tree from La Palma to Tenerife by the middle 19th century. Early introductions of tagasaste from the Canary Islands in the Pacific region confirm the importance of the Royal Botanic Gardens, Kew and the Botanic Gardens of Adelaide in the distribution of this exotic species in this region during the last century.

Introduction

The endemic *Chamaecytisus* from the Canary Islands comprises a taxonomic complex found in the islands of El Hierro, La Palma, La Gomera, Tenerife and Gran Canaria. The form endemic to La Palma is commonly known as "tagasaste" (*Chamaecytisus proliferus* (L. fil.)Link ssp. *palmensis* (Christ)Kunkel) which is broadly cultivated as a fodder tree in the Canary Islands, except on Fuerteventura and Lanzarote which are too dry. It is also the only endemic species from the archipelago which has achieved importance in agriculture around the world, particularly in parts of Australia and New Zealand. Even so, tagasaste is an under-exploited plant although it has proved to be an outstanding fodder species for arid areas (Logan, 1982).

All the other morphological forms of *C. proliferus* found in the archipelago are wild or semi-cultivated but are heavily grazed by goats or pruned by farmers for use as a fodder for livestock. These morphological types are popularly known as "escobón". Occasionally, tagasaste is referred to as "tree lucerne", but Staples (1985) has suggested that this alternative common name should be avoided since another fodder legume, *Medicago arborea*, is also known as tree lucerne.

Common name	Status	Distribution	Slope orientation	Altitude (m)
Tagasaste	Wild in La Palma cultivated elsewhere	All islands except Fuerteventura and Lanzarote	N	700-1300
White tagasaste	Wild	Le Palma	N S	1300-2000 1000-2000
White escobón of Tenerife	Wild	Tenerife	N	700-1300
White escobón of Gran Canaria	Wild Semi-cultivated	Gran Canaria	N	700-1300
Narrow leaved escobón	Wild	Tenerife La Gomera	N S S	1300-2200 700-2200 700-1000
Escobón of southern Gran Canaria	Wild	Gran Canaria	N S	1300-2000 500-2000
Escobón of El Hierro	Wild	El Hierro	N	700-1300

Table 1: The seven morphological types of *Chamaecytisus proliferus* (L. fil.)Link and their distribution in the Canary Islands.

The different morphological types of the *Chamaecytisus proliferus* complex have been given several taxonomic treatments, but taxonomists have been unable to agree upon the specific or infraspecific categories. In this paper we are less concerned with formal taxonomy than with the history of tagasaste as a cultivated plant. Table 1 gives a summary of the distribution of the seven morphological types which comprise the complex in the Canary Islands. Francisco-Ortega et al. (1990) have indicated that there are two morphological types of wild tagasaste on the island of La Palma which are clearly distinguishable from all the other forms of *C. proliferus*. Forms from the arid pine forest of La Caldera de Taburiente National Park and from the north of the island have rather silky leaves, pubescent on both surfaces, and usually are pale green in colour. Farmers from this area call these plants "white tagasaste" ("tagasaste blanco") or "blue tagasaste" ("tagasaste azul"). On the other hand, the form which has glabrous and dark green leaves is found wild on the sunny cliffs and within clear areas in the laurel wood, which is the rather humid vegetation of the north of the islands, in which *Laurus azorica* and *Myrica faya* are dominant species. This form is known as tagasaste or "black tagasaste" ("tagasaste negro"), and is the typical tagasaste which is cultivated in the Canary Islands and elsewhere. Since all the herbarium sheets of tagasaste at the Royal Botanic Gardens, Kew of specimens collected outside the Canary Islands have the morphological features of typical black tagasaste, we can surmise that white tagasaste was probably not introduced into Australia or New Zealand until recently. However, Wood (1989) has indicated that trials with this form have been carried out in Australia since 1989, following germplasm collection in La Palma. The introduction and history of tagasaste cultivation in New Zealand have been described by Webb (1980, 1982) and Davies (1982).

Our aim in this paper is to review the origin and history of tagasaste as a cultivated plant. This information could help focus future genetic resource studies and research on this species as a fodder tree for arid and semi-arid regions.

History of tagasaste as a cultivated plant

Early reports on the distribution and utilization of tagasaste in the Canary Islands

Within the genus *Chamaecytisus*, tagasaste is the only form which is reported as cultivated and of value for agriculture (Usher, 1974). Wolfel (1965) has stated that the name "tagasaste" had a Berber origin, suggesting that the plant was well known by the pre-Hispanic population of the island of La Palma. The oldest known reference to this name can be seen on a herbarium specimen from the Herbarium Webbianum in Florence (Fig. 1A, B). It is unclear where this specimen was collected. However, it appears to be white escobon of Tenerife and must have been collected on that island, since this form is not found in La Palma. Unfortunately it is not clear who was the collector of this specimen, as many botanists contributed to the Canarian collection of the Herbarium Webbianum (Steinberg, 1973). Neither does comparison of the handwriting of this label with those given by Steinberg (1973, 1977) and Burdet (1979) identify an obvious collector for this specimen. Four other herbarium specimens of *C. proliferus* from this collection also have a label with what appears to be the same handwriting, although only one of them is clearly dated as having been collected in Tenerife in 1845 (Fig. 1C).

Pérez de Paz et al. (1986) suggested that tagasaste might not only be endemic from La Palma but also from other islands in the archipelago, namely El Hierro, La Gomera and Tenerife. All the early reports found in the literature (Pérez & Sagot, 1867; Christ, 1888; Morris, 1893; Schenck, 1907; Burchard, 1911; 1929) do not agree with this point of view. Burchard (1929) has indicated that although tagasaste was planted in many areas of the north of El Hierro, farmers did not know of any wild populations of tagasaste in this island. During field studies carried out in 1989 (Francisco-Ortega et al., 1990) we were able to confirm that populations of wild tagasaste could only be found in La Palma.

Pérez (1879a) claimed that tagasaste had been cultivated in La Palma for a long time. However since many well-known naturalists such as Frutuoso (1590), Viera y Clavijo (1808), Webb & Berthelot (1836-1850), Berthelot (1837) made no mention of tagasaste in the cultivated areas of La Palma, we must assume that tagasaste has been under cultivation only from the 19th century. Before this it is likely that wild tagasaste plants were heavily pruned and grazed to feed cattle and goats in the same way that Pérez de Paz et al. (1986) and Francisco-Ortega et al. (1990) reported on the utilization of wild escobon and other wild endemic legumes in the archipelago.

The work of Dr Victor Pérez in the 19th century in Tenerife

The first reports concerning the utilization of tagasaste as a fodder tree were given by Victor Pérez (1862a, b) a native of La Palma who worked in Puerto de La Cruz (Tenerife) as a medical practitioner (Pérez-García, 1985). He considered it to be a native species from La Palma where it was considered a rather important fodder plant. He also observed that seeds and fodder from tagasaste were sold in markets and he gave an extensive account of traditional procedures for tagasaste cultivation. The earliest seed collections of tagasaste were mainly carried out by him and his son Dr Victor Pérez-Ventoso. They were the first to disseminate information about tagasaste as a fodder plant outside the Canary Islands.

Pérez (1862b) suggested that tagasaste should be planted as a fodder crop in the island of Tenerife. Morris (1893) indicated that tagasaste was introduced into Tenerife by Pérez in 1863, but Pérez-Ventoso (1892) stated that the plant had been introduced by his father in 1856. By 1912 tagasaste could be found growing on the lowest slopes in many parts of Tenerife (Sprague & Hutchinson, 1913).

Figure 1: A & B. Herbarium specimen of *Cytisus proliferus* (= *Chamaecytisus proliferus*) probably of white escobon of Tenerife from Herbarium Webbianum, Florence. Its label probably represents the oldest known reference to tagasaste in the Canary Islands (undated); C. Herbarium specimen of white escobon of Tenerife, collected in 1845.

Distribution and use of tagasaste outside the Canary Islands

Pérez (1862b) gave the first reports on the distribution of tagasaste from the Canary Islands. Seeds were sent to Algeria in order to evaluate its value for arid zones. Later he also sent tagasaste seeds to the south of mainland Spain, Corsica and California (Pérez & Sagot, 1892). Soon afterwards the plant was utilized and naturalized in California (Greene, 1891). Fairchild (1930) also reported that he brought seeds of tagasaste from the Canary Islands to California after his stay in the archipelago. Pérez became so enthusiastic with the spread of tagasaste that he published several papers (Pérez & Sagot, 1867; Pérez, 1879a, b, 1888) describing the procedures for its establishment and cultivation.

The first report from outside the Canary Islands on the value of tagasaste as a cultivated plant is from peninsula Spain (Colmeiro, 1871). This author gave a brief mention of this plant in his dictionary of "common names of useful plants from the Old and New World". Later, other agronomists from mainland Spain gave similar accounts about tagasaste and its utilization as a fodder tree (Garrido, 1902; Rodrigáñez, 1905). Despite the reports of these two authors on the use of tagasaste as a fodder plant which could be cultivated in the south of the Iberian peninsula, we have found no reports about its present utilization in the mainland Spain. Only Pereira-Coutinho (1913) has claimed that plants of tagasaste were naturalized in Tavira in the south of Portugal.

Between 1905 and 1915 several authors from the Canary Islands described the cultivation methods and advantages of tagasaste as a fodder species for arid zones (Benítez de Lugo, 1905; Pérez-Ventoso, 1910; 1916; Aganilob, 1915; Anon., 1915). Aganilob was the pseudonym of J. Bolinaga, who was the head gardener at La Orotava Botanic Garden in Tenerife. All these authors made similar recommendations on the use of tagasaste, and they considered that it should be utilized in summer when there were no other fresh forages available. They basically followed the recommendations given by Dr Victor Pérez. In these papers are given details of plant management such as restricting pruning to older branches. Procedures for breaking seed dormancy are discussed, and also the possibility of producing strains adapted to sandy or clay soils.

In 1879, Pérez sent seeds of tagasaste to India, South Australia (the Botanic Gardens of Adelaide) and South Africa via the Royal Botanic Gardens, Kew (Anon., 1891). A series of reports between 1879 and 1891 (Anon., 1879; 1880; 1881; 1882; 1891) indicated that the plant quickly became adapted to local conditions in South Africa and Australia, whilst the seedlings planted in Madras in India died shortly after germination. Apart from this first despatch of seeds by Pérez in 1879, more tagasaste seeds were received in Australia from Paris and Las Palmas de Gran Canaria (Anon., 1891). By 1907 tagasaste had escaped from cultivated areas and could be found naturalized in several parts of South Africa (Anon., 1907; Orpen, 1907). However, tagasaste was not successful as a cultivated plant in South Africa where Macowan (1904) indicated that it was toxic to horses and Orpen (1907) and Macmillan (1913) observed that seeds did not germinate rapidly. We have found no reports on the present utilization or distribution of tagasaste in southern Africa and it seems that early naturalized populations of this plant may have disappeared.

Tagasaste in Australia and New Zealand

In the years 1880-1883 and 1888-1890, Dr R. Schomburgk, the Director of the Botanic Gardens of Adelaide, briefly reported the advantages of tagasaste as a fodder plant, and seeds were offered to Australian farmers, although as he indicated in 1889, "pastoralists and agriculturists have hitherto shown a most remarkable degree of apathy". Schomburgk (1889) also claimed that tagasaste was cultivated in Madeira. However we do not believe that tagasaste was utilized on this island, and his account about tagasaste cultivation procedures probably referred to La Palma or Tenerife.

By 1919 the first report of tagasaste as an introduced plant in New Zealand was published (Anon., 1919). Nevertheless Davies (1982) considered that tagasaste had been being utilized as a forage species in New Zealand from the late 1800s, which is probably true since the Botanic Gardens of Adelaide had received the first request for seeds of tagasaste from "the neighbouring British colonies in 1882" (Schomburgk, 1883). Maiden (1908) observed that specimens of tagasaste were planted in Tasmania in 1908. It is likely that the first plantings throughout the Pacific region were established from seeds originally supplied from Australia. The role of Australia as a source of seeds of tagasaste for the area is clearly indicated by Degener (1946) who found naturalized tagasaste in pastures at Mouri in the Hawaiian Islands in 1927. He claimed that a Mr F.G. Krauss introduced tagasaste from Australia together with other forage plants between 1910 and 1912.

Other places where tagasaste has been seen as a naturalized plant are Java (Backer & Bakhuizen, 1963), Kenya and Tanzania (Milne-Redhead & Polhill, 1971; Lock, 1989) and North Africa (Quezel, 1987). Although there is no information concerning their origin, it does seem likely that the stands in Java and East Africa originated from seeds from Australia or New Zealand, whereas North African populations probably had their origin in germplasm from the Canary Islands. Recent reports on the introduction of tagasaste in the Asiatic region (Anon., 1990) indicate that tagasaste cultivation was started in some areas of China from germplasm provided by Australian nurseries.

The first experimental plots of tagasaste in New Zealand were established in 1977 (Davies, 1982). Results from various agronomic trials in New Zealand have been reported by Logan (1982) and Logan & Radcliffe (1985) who indicated that as a legume species, tagasaste could play an important role in agroforestry systems for arid regions. These reports considered tagasaste as one of the most appropriate species for these systems as it not only seems free of toxic compounds but also is highly productive. Wheeler & Hill (1990) indicated that despite its low dry matter digestibility, tagasaste has such a high growth rate that it could be utilized as fodder as early as 12 months after planting. They regarded tagasaste as the most suitable shrub for temperate zones of Australia. As with other trees and shrubs, tagasaste has advantages over many herbaceous species since it provides better control of soil erosion and a reserve of fodder throughout the whole year. Once established it is resistant to overgrazing and can be utilized in association with other species leading to an efficient use of land resources.

In 1987, Woodfield and Forde reported the first study of variability in tagasaste (Woodfield & Forde, 1987). They found that considerable variation existed both within and between populations from New Zealand, and that broad-sense heritability values ranged between 35 and 84%, suggesting that much of the variation found in some characters is highly heritable. They did not find any correlation between patterns of variation and geographical origin of these populations. This indicates that almost one century after its introduction into New Zealand, there has been little or no population differentiation in that country.

Results of this study, and of the reproductive biology of the plant obtained by Webb & Shand (1985) suggested that although tagasaste is self-compatible, allogamy plays an important role in its breeding system. They found that the species has a long flowering period and produces a large number of flowers. They observed that honey bees do visit the flowers although they are not able to trip them. They usually rob nectar through the side of the flower or visit flowers already tripped by other insects. These results indicate that the species could be considered more as a source of nectar than of pollen for honey bees.

Problems with tagasaste as a cultivated fodder species

There are perhaps two principal reasons why tagasaste has not been exploited more widely. First, it has been reported to have low frost tolerance (Anon., 1907; Morris, 1893; Davies, 1985). Our recent field studies indicate that populations of white tagasaste and narrow-leaved escobon are found in areas of La Palma and Tenerife where periodic frosts occur, particularly at high altitudes in the Las Cañadas del Teide National Park in Tenerife. Whilst tagasaste seems to be the form with the best nutritional quality, there may be other forms with other attributes such as frost tolerance which should be evaluated for fodder quality.

Secondly, seeds can be difficult to germinate. It has been claimed that farmers in La Palma had problems in establishing tagasaste fields due to lack of seed germination, and that seeds sown the first year usually germinated the following year (Pérez, 1879a, b). This poor germination has been reported as a common feature of the Genisteae by Polhill (1976). Details about the problems caused in the establishment of tagasaste as a crop by the lack of germination and procedures to overcome this were given by Pérez (1879a, b), Snook (1986) and Pérez de Paz et al. (1986). All these authors suggested that seed dormancy could be broken either by scarification or by immersing the seeds in boiling water for a few minutes. This latter treatment if prolonged could lead to low viability and germination. Further research is needed in this field in order to determine which factors control the germination physiology of *C. proliferus.*

Conclusions

The history of tagasaste as a cultivated plant is another example of the important role that botanic gardens had in the distribution of exotic species during the last century (Plucknett et al., 1987). Introduction of this fodder shrub from the Canary Islands to the Pacific region was made possible by the early accounts and seed collection by Dr Victor Pérez and through the links which existed between the Royal Botanic Gardens, Kew and the Botanic Gardens of Adelaide.

One consequence of the early successful introduction into Australia and New Zealand is that the present gene pool of tagasaste is rather narrow compared to that which exists in the Canary Islands. However, the range of genetic variation now available in genebanks following recent germplasm collection in the Canary Islands (Francisco-Ortega et al. 1990) should lead to greater utilization of the plant genetic resources of the endemic *Chamaecytisus* from these islands.

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A TAXONOMIC REVISION OF THE GENUS *ONCINOCALYX* F.MUELL. (VERBENACEAE)*

Ahmad Abid Munir

State Herbarium, Botanic Gardens,
North Terrace, Adelaide, South Australia 5000

Abstract

A taxonomic revision of the monotypic genus *Oncinocalyx* is presented and its affinities and distribution are considered. A detailed description of the type species, *O. betchei*, is supplemented by a habit sketch of a flowering branch and analytical drawings of the flower.

Taxonomic History of the Genus

The genus *Oncinocalyx* was described by F. Mueller (1883) with one species *O. betchei*, the type of which was collected by E. Betche (s.n.) from Gunnedah near the Namoi River in New South Wales, Australia. It was then considered to "mediate the transit from Verbenaceae to Labiatae". In the protologue, F. Muell. (1883) drew special attention to some characters that are in common with *Oncinocalyx* and the genera *Notochaete* Benth. and *Hyptis* Jacq. in the Lamiaceae, *Teucridium* Hook.f. in the Verbenaceae and *Phryma* L. in the Phrymaceae, but he apparently retained it in the Verbenaceae. A year later, C. Moore (1884) placed the genus in the Lamiaceae but F. Mueller (1889) retained it in the Verbenaceae. The family Verbenaceae has been accepted for the genus by all subsequent botanists.

In 1895, Briquet re-classified the Verbenaceae and upgraded the tribe Viticeae to a subfamily Viticoideae. The latter was subdivided into four tribes with *Oncinocalyx* in the tribe Clerodendreae. This classification was adopted by Dalla Torre & Harms (1904), Moldenke (1959, 1971) and Bhoj Raj (1983). Post & Kuntze (1904), however, relegated the subfamily Viticoideae to the synonymy of tribe Viticeae, and placed *Oncinocalyx* in the tribe Viticeae. This was later accepted by Maiden & Betche (1916). In 1934, Junell referred this genus to the subfamily ("Tribus") Viticoideae tribe ("Subtrib.") Ajugeae. The tribe Ajugeae has not been accepted for the genus by any subsequent botanist. Most botanists, however, have retained *Oncinocalyx* in the Verbenaceae without reference to any subfamily or tribe. So far, the monotypic status of this genus has not changed.

ONCINOCALYX F. Muell.

Oncinocalyx F. Muell., S. Sci. Rec. 3, no. 3 (1883) 69; C. Moore, Cens. Pl. N.S.W. (1884) 53; F. Muell., Sec. Syst. Cens. Aust. Pl. 1 (1889) 171; Briq. in Engl. & Prantl, Pflanzenfam. 4, 3a (1895) 177; Post & Kuntze, Lexic. Gen. Phan. (1904) 688; Dalla Torre & Harms, Gen. Siphon. part 6 (1904) 433; Maiden & E. Betche, Cens. N.S.W. Pl. (1916) 178; Junell, Symb. Bot. Upsal. 4 (1934) 130; Mold., Résumé Verbenac. etc. (1959) 413; N. Burb., Dict. Aust. Pl. Gen. (1963) 213; Mold., Fifth Summary Verbenac. etc. 2 (1971) 763; Cliff. &

*The present treatment of the genus *Oncinocalyx* is the 10th in the series of taxonomic revisions in the family Verbenaceae in Australia. See Munir in the *J. Adelaide Bot.Gard.* 1982 (*Callicarpa*), 1984a (*Premna*), 1984b (*Gmelina*), 1985 (*Viticipremna*), 1987a (*Vitex*), 1987b (*Faradaya*), 1989 (*Clerodendrum*), 1990a (*Glossocarya*), 1990b (*Huxleya*).

Ludlow, Keys Fam. Gen. Qld Fl. Pl. (1972) 124; S. Jacobs & Pickard, Pl. N.S.W. (1981) 209; Munir in Morley & Toelken (eds), Fl. Pl. Aust. (1983) 288; N. Beadle, Students Fl. NE N.S.W., part 4 (1984) 355; Bhoj-Raj, Rev. Palaeobot. Palynol. 39 (1983) 375; Stanley in Stanley & Ross, Fl. SE Qld 2 (1986) 365.

Type species: *O. betchei* F. Muell., S. Sci. Rec. 3, no. 3 (1883) 70.

Herbaceous perennials or undershrubs. *Stem* erect, branched, angular. *Leaves* simple, decussate, sessile, exstipulate, narrow-linear or subulate, entire, reticulate-veined, unicostate. *Inflorescence* cymose; cymes in axillary clusters, sessile. *Flowers* bracteate with 2 bracteoles, pedicellate or subsessile, zygomorphic, bisexual, hypogynous. *Calyx* of 5 fused sepals, urceolate in plate or obconical, persistent, 10-nerved, 5-toothed, with teeth hooked at end, non-accrescent. *Corolla* of 5 fused petals scarcely longer than calyx, tubular below, bilabiate above, lower lip 3-lobed, upper lip 2-lobed; tube almost cylindrical. *Stamens* 4, didynamous, exserted, epipetalous; filaments filiform; anthers dorsifixed, unilocular by confluence of locules. *Ovary* bicarpellary, syncarpous, 4-lobed, 4-locular, with one ovule in each cell attached to an axile placenta; style terminal, exserted, filiform, with 2 stigmatic lobes at the top. *Fruit* dry, schizocarpic, splitting into 4 mericarps, enclosed in the persistent calyx.

Number of species: 1

Derivation of name

The generic name is derived from Greek, *onkinos*, a hook; *kalyx*, cup, calyx; referring to the hooked calyx-lobes.

Distribution (Map 1)

The genus *Oncinocalyx* is endemic to the eastern part of mainland Australia where it has been recorded from along the south-eastern border of Queensland and north-eastern part of New South Wales.

Comments

In the protologue, F. Mueller (1883) described the flowers as 2-3 in each axil, stamens not long exserted and the style very short. During present investigations, however, the flowers are now found to be mostly 3-5 in each sessile axillary cluster and stamens and style reasonably exserted in mature flowers.

Affinities

According to F. Mueller (1883) this genus is intermediate between Verbenaceae and Lamiaceae. Among modern phylogenists, Cronquist (1968, 1981), Dahlgren (1977, 1980), Takhtajan (1969, 1980) and Thorne (1976, 1977) are in agreement on the close relationship of these two families, but the boundary between them by characters of convenience is uncertain. Cronquist (1968) stated that "the relationship of the Verbenaceae to Labiatae has been evident to most botanists for many years. Indeed it is difficult to know where to draw the line between them, and a case might be made for treating the present Verbenaceae and Labiatae as the more primitive and more advanced segments of a single family". While stressing the relationship of these families, Cronquist (1981) regarded the Verbenaceae and

Lamiaceae as a closely related pair of families, which together include about three-quarters of the species in the order Lamiales. In his view, "most authors agree that the Lamiaceae represent the realization and culmination of trends that begin in the Verbenaceae. The boundary between the two families is arbitrary and in part merely conventional, but no other means of distinguishing between them seems more satisfactory, and the conceptual utility of recognizing two groups rather than only one has seldom been challenged." All the above phylogenists seem to agree with this view and have retained these families in the order Lamiales, although their classification differ from each other in minor details or major groupings. Since the delimitation of the two families is "arbitrary", border-line cases are not easily placed unless they can be shown to be part of an evolutionary line. *Teucridium*, *Teucrium* and *Notochaete* are often mentioned as genera closely related to *Oncinocalyx* (Mueller, 1883), but although they show some similar features, their position between the two families remains uncertain until detailed monographs become available.

The genus *Oncinocalyx* is here retained in the Verbenaceae because of the non-verticillate inflorescence, absence of oil glands, presence of 4 fertile stamens and strictly non-gynobasic ovary. It showed a few other generic characters which are found both in Verbenaceae and Lamiaceae, such as the presence of quadragular stems, opposite leaves, bilabiate corollas, didynamous stamens, single ovule in each ovary cell with micropyle directed downward, schizocarpic fruit with four one-seeded mericarps and non-endospermic seeds. Overall, this genus seems to be closer to the Verbenaceae than Lamiaceae but it will remain a problem until a clearer delimitation of the two families has been achieved.

Oncinocalyx betchei F. Muell., S. Sci. Rec. 3, no. 3 (1883) 70; C. Moore, Cens. Pl. N.S.W. (1884) 53; F. Muell., Sec. Syst. Cens. Aust. Pl. 1 (1889) 171; Dixon, Pl. N.S.W. (1906) 237; Maiden & E. Betche, Cens. N.S.W. Pl. (1916) 178; Junell, Symb. Bot. Upsal. 4 (1934) 130; C. White, Proc. Roy. Soc. Qld 47 (1936) 74; Mold., Résumé Verbenac. etc. (1959) 209; Fifth Summary Verbenac. etc. 1 (1971) 347; Sixth Summary Verbenac. (1980) 337; S. Jacobs & Pickard, Pl. N.S.W. (1981) 209; N. Beadle, Students Fl. N.E. N.S.W., part 5 (1984) 855, fig. 375D; Bhoj-Raj, Rev. Palaeobot. Palynol. 39 (1983) 358, 375; Stanley in Stanley & Ross, Fl. S.E. Qld 2 (1986) 365.

Lectotype: *E. Betche s.n.*, Namoi River near Gunnedah, N.S.W., Australia, -i.1883 (MEL 583547, lectotype designated here; CAS 31218, HBG, K, NSW 145058 - isolectotypes (F & NY have photographs of the isolectotype in CAS).

Typification

O. betchei is based on Ernst Betche's un-numbered collection from near the Namoi River, comprising at least 5 duplicates. As no holotype was designated by the author (F. Mueller), a lectotype is chosen here. Of all the syntypes, the one preserved in Herb. MEL (No. MEL 583547) is particularly complete and well preserved. The specimen was certainly used by the author in preparing the original description as it carries an envelope containing F. Mueller's hand-written description and notes. It has, therefore, been selected here as the lectotype of this species.

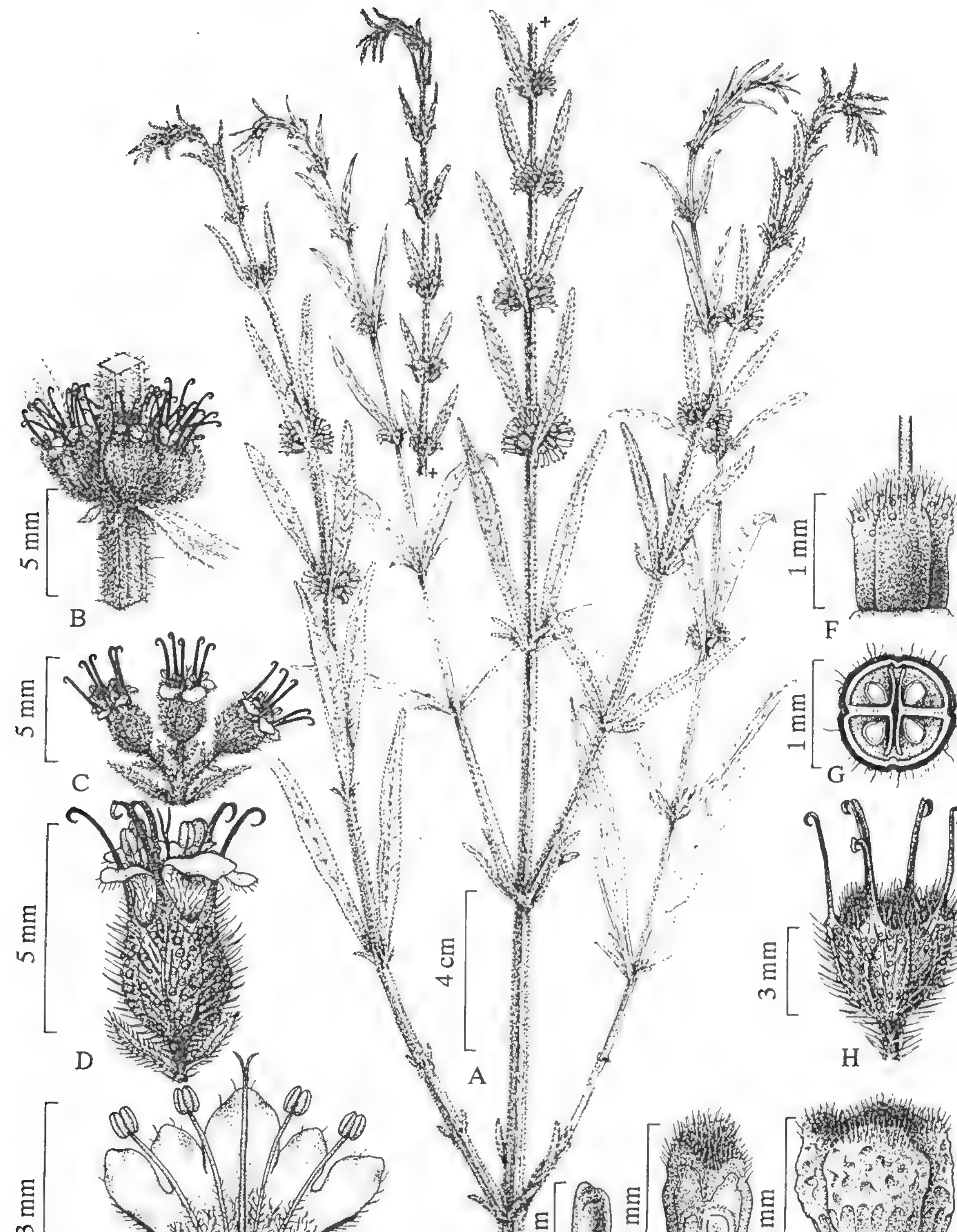


Fig. 1. *Oncinocalyx betchei* F. Muell. (A-K, *A.N. Rodd 4069*: MEL). A, habit sketch of a flowering branch; B, portion of stem with opposite clusters of cymes; C, cyme showing bracts and bracteoles; D, flower; E, flower with corolla vertically cut open showing androecium and gynoecium; F, ovary; G, transverse section of ovary; H, fruit with persistent calyx; I, naked fruit; J, mericarp; K, seed.

Description (Fig. 1)

Perennial herb or undershrub to c. 1 m tall. *Stem* distinctly tetragonal, grooved, often branched near the base, pubescent, 1.5-4 mm diam. *Leaves* opposite, sessile, linear-subulate, acute, entire, with recurved-revolute margins, (15-) 20-60 (-75) mm long, (1.5-) 2-5 (-7) mm wide, pubescent, the upper surface groove above the middle, the lower surface with minute glands concealed by pubescence. *Cymes* almost sessile in the axils of upper leaves. *Flowers* mostly in cluster of 3-5 in the upper leaf-axils, rarely solitary, shortly pedicellate, bracteate, with two minute bracteoles at the base; pedicels glandular and pubescent, 1-3 mm long; bracts linear-subulate, glandular and pubescent abaxially, 2-4 (-5) mm long, c. 0.5 mm wide. *Calyx* tubular below, 5- (sometimes 6- or 7-) lobed above, glandular and pubescent outside the tube, glabrous inside; lobes equal, subulate, strongly hooked, glabrous in the distal half, 1-3 mm long, 1-1.5 mm wide at base; tube obconical, 1.5-2 (-3) mm long, 2-2.5 mm wide at top. *Corolla* white, tubular, 2-lipped, scarcely protruding beyond calyx-lobed, glandular and pubescent outside, villous inside the tube, 4-5 mm long; lower lip 3-fid, with middle lobe larger, elliptic-ovate, acute, 1.5-2.5 mm long, 1-1.5 mm wide, the lateral lobes shorter than the middle one, oblong-ovate, 1-1.5 mm long; upper lip 2-lobed, lobes almost equal, oblong-elliptic, 1.5-2.5 mm long, 1-1.5 mm wide; tube almost cylindrical, 1.5-2.5 mm long, 1-1.5 mm diam. *Stamens* exserted; filaments white, filiform, attached inside the corolla-tube towards base, villous in the lower half, glabrous above, 2.5-4 mm long; anthers reniform, unilocular, bivalved, ± 0.5 mm long. *Ovary* globose, glandular and pubescent, shortly 4-lobed, 4-locular, with one ovule in each cell attached below the middle, ± 1 mm diam.; style exserted, filiform, glabrous, 2.5-3 (-4) mm long; stigma subulate, deeply 2-lobed, glabrous, 1-2 mm long. *Fruit* obovoid-globose, 4-lobed, scarcely longer than the persistent calyx, glandular, pubescent (particularly on top), splitting into 4 mericarps, 2-3 mm long, 1.5-2.5 (-3) mm diam. near top.

Specimens examined

AUSTRALIA: NEW SOUTH WALES: *Bates 12601*, Moonbi Gap, 20.xi.1987 (AD); *Betche s.n.*, Namoi River near Gunnedah, -.i.1883 (MEL 583547, lectotype; CAS 31218, F 1252688; photograph of CAS, HBG, K, NSW 145058, NY photograph of CAS - isolectotypes); *Blakely s.n.*, Kootingal, -.iv.1927 (NSW 145068); *Boorman s.n.*, Gunnedah, -vi.1907 (BR, CSPU 121595, GH, K, L 90921-611, L 908140-1789, LE, MEL 583546, NSW 145066, NY, NY photograph of CSPU, UPS, W, Z); *Boorman s.n.*, loc. cit., -viii.1907 (B 2 spec., M, UC); *Boorman s.n.*, loc. cit., -ix.1910 (L 912184-530, L 92126-13, M, P); *Cambage 2365*, Nandewar Range, 4.xi.1909 (NSW, SYD); *Cambage 3594*, c. 3.2 km N Boggabri, 17.x.1912 (NSW, SYD); *Carter s.n.*, c. 9.6 km N Coonabarabran, -ii.1955 (NSW 145062, NSW 214466, NSW 214467); *Cleland s.n.*, Gunnedah, undated (AD); Council of Shire of *Cudgegong s.n.*, Mudgee district, 14.vi.1947 (NSW 145059); *Coveny 2294*, c. 3.2 km NW Boggabri, 8.x.1969 (NSW); *Froggatt s.n.*, Warrah Creek, -iii.1920 (NSW 145070); *Gauba s.n.*, near Coonabarabaran, 9.iii.1954 (CBG 011911); *Harvey s.n.*, Dunedoo, undated (C, NSW); *Irvine 12500*, Singleton, 6.v.1966 (NSW 214468); *Johnson & Briggs BGB 2991*, Mt. Martha, 8 km SW Curlewis, 15.xi.1969 (K, NSW); *Johnson & Briggs LAS 8182*, 1 km W Quirindi, 8.xi.1975 (NSW); *R.I. Johnson s.n.*, Hargraves, -.viii.1961 (NSW 145060); *Jurjens s.n.*, Duri Mountain, 23.i.1973 (NSW 145061); *Porter s.n.*, Manilla, -xii.1950 (NSW 145069); *Rodd 4069*, Barraba-Bundarra Road, near Ironbark Creek, 37 km from Barraba, 21.xi.1984 (MEL); *Salasoo 2333*, Gilgandra Road, c. 3.2-5 km SSE Coonabarabran, 7.i.1962 (NSW); *"Shire Clerk" s.n.*, Barraba, 26.iii.1929 (NSW 145065); *Sonter s.n.*, c. 6.4-8 km S Bingora, 18.xi.1964 (NSW 89916); *"Stock Inspector" s.n.*, Inverell, 29.v.1934 (NSW 145063); *Waterhouse s.n.*, Gunnedah, -.iii.1914 (NSW 145064); *Young s.n.*, Upper Bingara, -.i.1949 (NSW 145067).

QUEENSLAND: *Fraser s.n.*, Goondiwindi, undated (BRI 267343, BRI 267345, GH); *Thompson s.n.*, Ardenlea, Stanthorpe Shire, 3.xi.1986 (BRI 391845).

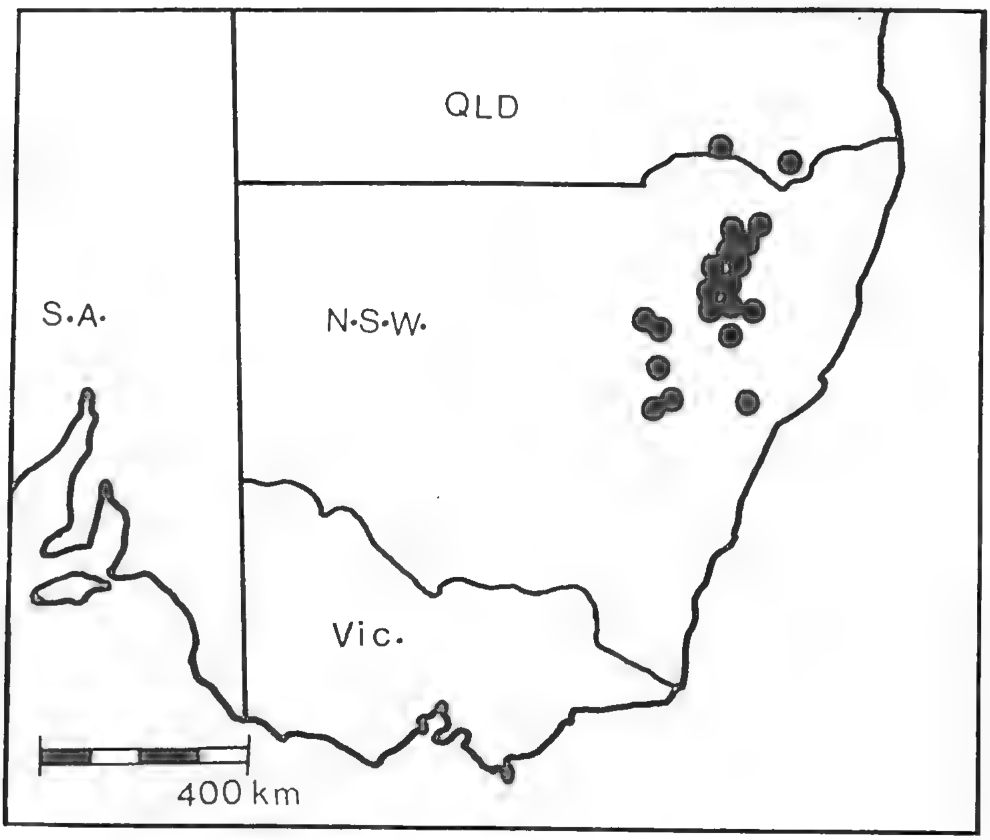
Distribution and ecology (Map 1)

O. betchei is endemic to New South Wales and Queensland in Australia. The major distribution is in New South Wales where it has been recorded from between 29° and 33°S and between 149° and 152°E. Within this range most localities are to the west and north-west of Newcastle and to the east and north-east of Dubbo. The frequency of occurrence is

chiefly along the Namoi River and around the townships of Gunnedah, Boggabri, Coonabarabran, Mudgee, Tomworth and Bingara.

Distribution in Queensland is along the southern boundary of the State where it has been recorded from near the township of Goondiwindi and Stanthorpe. According to Stanley (1986), this taxon is "restricted to a small area around Goodiwindi in the southern Darling Downs district and adjacent areas of N.S.W."

According to collectors' field notes, this species grows chiefly on "rocky hillside" and "on slopes below conglomerate rocks". It is also recorded from "rock on top of volcanic hill", in "loose stony country", "granite sands by rock outcrop" and on "light sandy soil of natural grazing land". Beadle (1984) "recorded near Tamworth (Loomberah) on "red basalt" in grazing land, and at Goodiwindi (Q) on stony ground."



Map 1. Distribution of the genus *Oncinocalyx* F. Muell.

Comments

One of Harvey's (s.n.) collections of this taxon was identified as "Oncinocalyx occidentalis MS", and its locality given as "Dunedin W.A.". According to present investigation, there is no *Oncinocalyx* species published under the name *O. occidentalis*, nor

has the occurrence of this genus in Western Australia been confirmed. As mentioned under the "distribution", this taxon occurs only in mid north-eastern New South Wales and adjacent border areas of Queensland. The locality "Dunedin W.A." could be a mistake for Dunedoo in New South Wales which is well within the distribution range of this species.

Beadle (1984) and Stanley (1986) described the stamens respectively as "enclosed" and "included in corolla". In fact the stamens and style are always exserted in mature flowers of this species. It seems that either Beadle and Stanley saw flower-buds only or they may have been misled by the protologue where stamens were said to be "shorter than corolla". Regarding the number of flowers in a cyme ("group"), Stanley (1986) reported "axillary, solitary or in groups of 2-3". During present studies, however, the flowers were found to be mostly in clusters of 3-5 in the upper leaf-axils. As far as the flower stalk is concerned, Beadle (1984) considers them "sessile", but during present investigations the flowers are found to be with pedicels 1-3 mm long. Flowers in each cluster (cyme) are borne on a very short axillary peduncle. Moreover, each flower has a linear-subulate bract and two minute bracteoles at the base which have not been previously recorded.

Generally, each calyx has 5 lobes, but in *Porter's s.n.* collection (NSW 145069) the number of calyx-lobes range from 5-7 in flowers of the same cluster (cyme). The corolla appears to be shorter than calyx because often it does not protrude beyond the tips of the calyx-lobes. The ovary is 4-lobed but the style is not gynobasic as in the Labiatae or in some Boraginaceae genera.

This species is sometimes considered a nuisance because the hooked calyx-lobes with the enclosed fruit can become attached to the fleece of sheep and are not easily separated.

Acknowledgements

The author is grateful to Dr J. P. Jessop and Dr H. R. Toelken for comments on the draft of this manuscript; to Miss G. Denny, Librarian, Adelaide Botanic Garden, for help in procuring the relevant literature; to Mr G. R. M. Dashorst for preparing the illustration; to Miss M. Eadsforth for typing the manuscript.

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TWO NEW SPECIES OF *DICRASTYLIS* J.DRUMM. EX HARVEY (CHLOANTHACEAE) FROM WESTERN AUSTRALIA

Ahmad Abid Munir

State Herbarium, Botanic Gardens,
North Terrace, Adelaide, South Australia 5000

Abstract

Two new *Dicrastylis* species, *D. archeri* and *D. capitellata* are described from Western Australia. A detailed description of each species is supplemented by a habit sketch of a flower branch and analytical drawings of the flowers. The affinities and distribution are considered.

Introduction

The first comprehensive treatment of the genus was published by Bentham (1870) with only five species. Later, F. Mueller (1889) recorded ten species in the genus and Diels & Pritzel (1904) reported eleven from Western Australia. The most recent taxonomic revision of the genus, however, was published by Munir (1978) with 26 species, of which more than half were new.

Two new species of the genus have been recently collected from near Mt Heywood, north-east of Esperance. They are here described and fitted into part of the original key (Munir, 1978) to show similarities and differences with closely related species. A full discussion of their affinities is provided under each species.

Key to the species

1a. Cymes of subglobose clusters, mostly sessile, arranged spicately along terminal axis; leaves linear, with recurved margins 6

b. Cymes lax or of subglobose clusters, pedunculate, arranged in corymbose thyrse; leaves as above or variously shaped and flat 2

2a. Cymes congested, forming somewhat woolly clusters .... 12. *D.morrisonii* & allied species

b. Cymes in lax thyrse, not forming woolly clusters 3

3a. Leaves typically obovate .... 6. *D. obovata*

b. Leaves variously shaped, not obovate 4

4a. Stems and leaves conspicuously tomentose .... 8. *D. parvifolia*, *D. fulva* & allied species

b. Stems and adaxial leaf surface becoming glabrous or apparently so to the naked eye 5

5a. Stems golden-orange or ferruginous; leaves flat, apiculate; flowers 5 - 6 mm long; corolla-tube almost glabrous inside, lobes ± spathulate, 2 - 2.5 mm long .... 7. *D. linearifolia*

b. Stems cineraceous; leaves with recurved margins, obtuse; flowers 2.5 - 3 mm long; corolla-tube villous inside, lobes elliptic, 1.5 - 2 mm long .... 7A. *D. archeri*

6a. Leaves mostly in whorls of 3, 2 - 6 mm broad, tomentose all over; cymes mostly opposite, 7 - 15 mm diam.; flowers 8 - 9 mm long; calyx-lobes tomentose on the upper half inside, 3 - 3.5 mm long .... 18. *D. lewellinii*

b. Leaves opposite, 1 - 1.5 mm broad, puberulous-scabridous adaxially; cymes always alternate, 5 - 7 (-8) mm diam.; flowers 4 - 4.5 mm long; calyx-lobes glabrous inside, 1.5 - 2 mm long .... 18A. *D. capitellata*

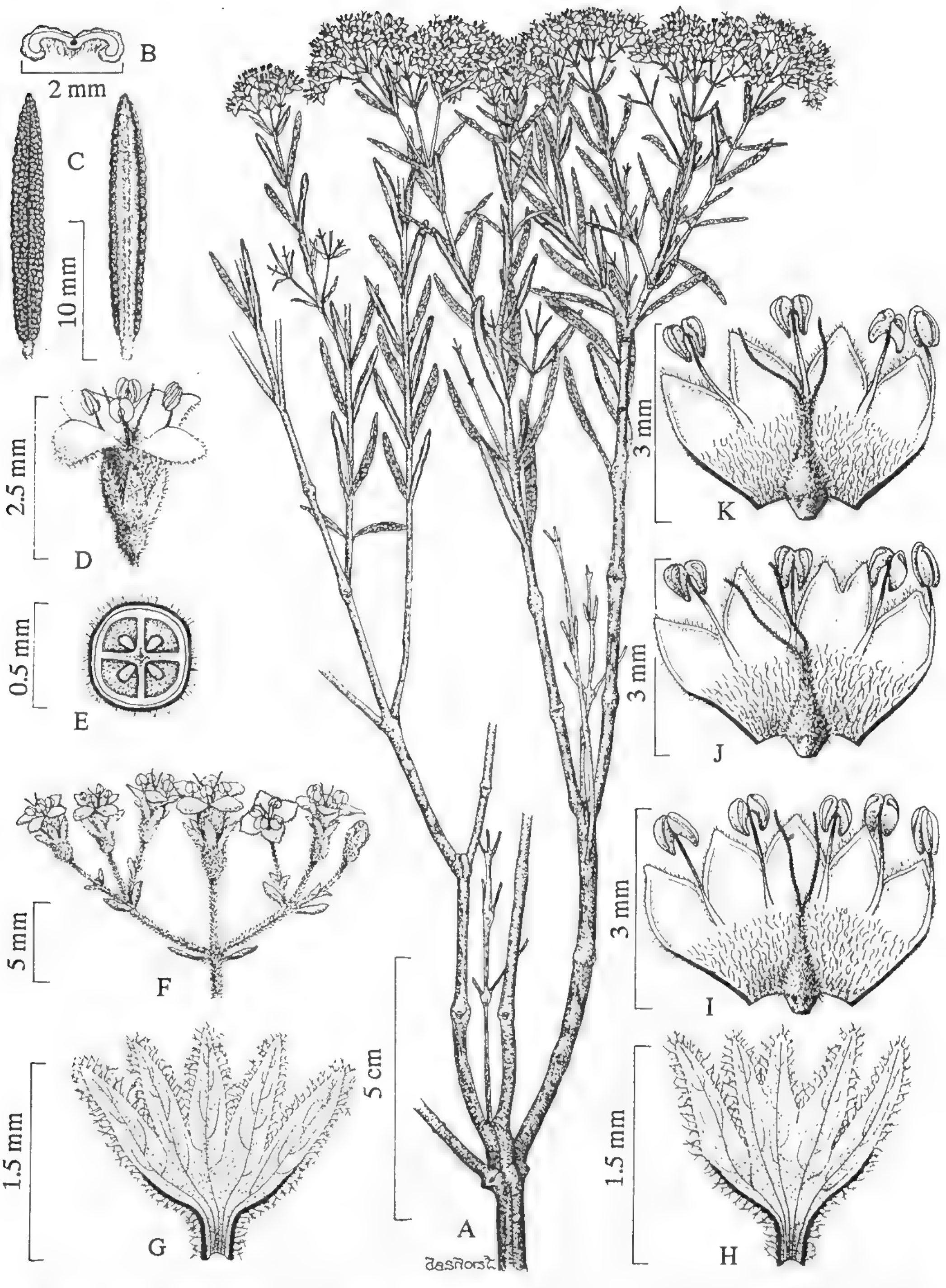


Fig. 1. *Dicrastylis archeri* Munir (A-K, *W.R. Archer 112907*: AD, holotype). A, habit drawing of a flowering branch; B, transverse section of leaf; C, leaf showing rugose and glabrous adaxial surface and greyish-pubescent abaxial surface; D, flower; E, transverse section of ovary; F, cyme; G, calyx vertically cut open showing glabrous inside; H, calyx cut open showing tendency towards reduction in lobes; I, corolla cut open showing androecium and gynoecium; J, corolla cut open showing 4 stamens and tendency towards reduction in corolla-lobes; K, corolla cut open showing 4 corolla-lobes and 4 stamens.

Dicrastylis archeri Munir, sp. nov.

Frutex erectus, usque 1 m altus. *Caules* erecti, ramosi, cylindrici, cinerascenti-pubescentes, lignosis. *Folia* simplicia decussata, sessilia, linearia vel peranguste lanceolato-linearia, glabra rugosaque superne (adaxialiter), infra (abaxialiter) cinerascenti-pubescentia, ad apicem obtusa, marginibus recurvatis, (5-) 10 - 20 (-25) mm longa, 1 - 2 mm lata. *Inflorescentia* cymosa; cymae in thyrso corymboso dispositae, semi-laxae; pedunculi primarii tenues, cinerascenti-pubescentes vel pallide brunneo-cinerascenti-pubescentes, 10 - 25 mm longi. *Flores* 4 vel 5-meri, terminales pro parte maxima 4-meri, pedicellati, bracteati, cremeo-albi, 2.5 - 3 mm longi; pedicelli 1 - 2.5 mm longi, dense albido- vel cinerascenti-pubescentes. *Calyx* 4 vel 5-lobatus, basaliter tubo vadoso (± 0.5 mm longo). *Corolla* cremeo-alba, superne 4 vel 5-lobata, infra tubularis, 2.5 - 3 mm longa, extra cinerascenti-pubescens, in tubo villosa; lobi elliptici vel ovato-elliptici, versus apicem gradatim angustati, 1.5 - 2 mm longi, 1 - 1.5 mm lati; tubus vadosus, 0.5 - 1 mm longus. *Stamina* 4 vel 5, exserta, in fauce corollae inserta; filamenta filiformia, glabra, ± 1.5 mm longa; antherae 2-lobatae, dorsifixae, ambito ± rotundatae, 0.5 mm diametro, lobi liberi et in parte inferiori divergentes, longitudinaliter dehiscentes. *Ovarium* globosum, dense tomentosum, ± 0.5 mm diametro, 4-loculatum in quoque loculo ovulo uno; stylus exsertus, profunde 2-ramosus, 2.5 - 3 mm longus, in dimidio inferiore dense tomentosus, lobi (rami) filiformes, in dimidio superiore glaberi, apicaliter stigmati. *Fructus* non visus.

Type: *W.R. Archer 112907*, 23.5 km NNE of Mt Heywood, 33°09'S, 122°37'E, 1.xii.1990 (AD, holotype; PERTH, isotype).

Description (Fig. 1)

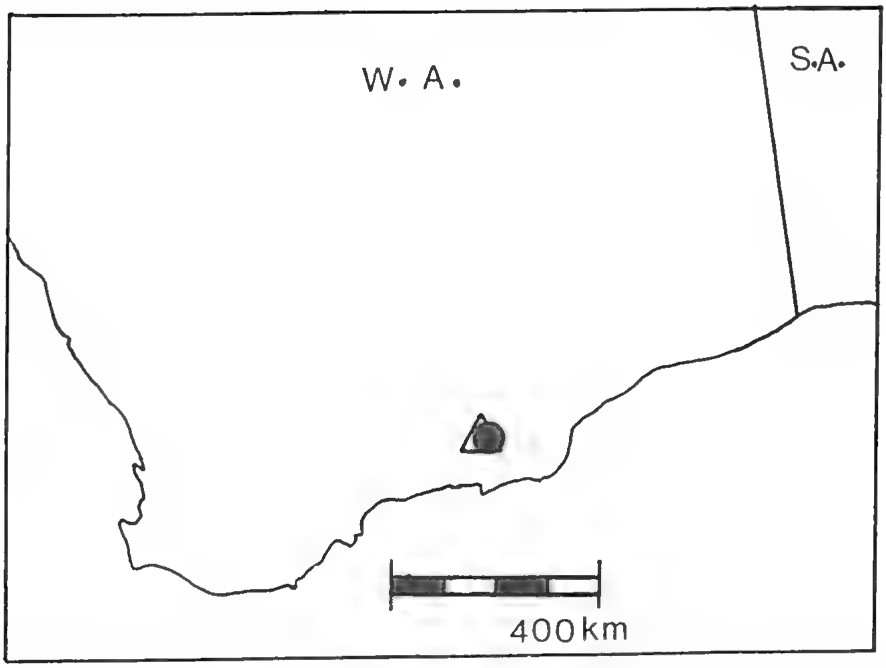
Upright shrub to 1 m high. *Stems* erect, branched, cylindrical, greyish-pubescent, woody. *Leaves* simple, decussate, sessile, linear, oblong or sometimes narrowly linear-lanceolate, glabrous and rugose above (adaxially), greyish-pubescent below (abaxially), obtuse at the tip, with recurved margins, (5-) 10 - 20 (-25) mm long, 1 - 2 mm wide. *Inflorescence* cymose; cymes arranged in a corymbose thyrse, semi-lax; primary peduncles slender, greyish pubescent to light brownish-grey pubescent, 10 - 25 mm long. *Flowers* 4 or 5-merous, the terminal ones mostly 4-merous, pedicellate, bracteate, creamy-white, 2.5 - 3 mm long; pedicels 1 - 2.5 mm long, densely whitish- or greyish-pubescent. *Calyx* 4 or 5-lobed with a shallow tube at the base, 1.5 - 2 mm long, whitish- or greyish-pubescent outside, glabrous inside; lobes linear-lanceolate, 1 - 1.5 mm long; tube shallow ± 0.5 mm long. *Corolla* creamy-white, 4 or 5-lobed above, tubular below, 2.5 - 3 mm long, greyish-pubescent outside, villous inside the tube; lobes elliptic or ovate-elliptic, gradually narrowing towards the apex, 1.5 - 2 mm long, 1 - 1.5 mm wide; tube shallow, 0.5 - 1 mm long. *Stamens* usually 4, sometimes 5, exserted, inserted in the corolla-throat; filaments filiform, glabrous, ± 1.5 mm long; anthers 2-lobed, dorsifixed, ± rounded in outline, 0.5 mm diam., lobes free and divergent in the lower half, longitudinally dehiscent. *Ovary* globose, densely tomentose, ± 0.5 mm diam., 4-locular with one ovule in each cell; style exserted, deeply 2-branched, 2.5 - 3 mm long, densely tomentose in the lower half, lobes (branches) filiform, glabrous in the distal half, stigmatic at the end. *Fruit* not seen.

Specimens examined

AUSTRALIA: WESTERN AUSTRALIA: *W.R. Archer 112907*, 23.5 km NNE of Mt. Heywood, 33°09'S, 122°37'E, 1.xii.1990 (AD, holotype; PERTH, isotype); *W.R. Archer 2411904*, loc. cit., 33°09'S, 122°39'E, 24.xi.1990 (AD, CANB, MEL — paratypes); *W.R. Archer 112908*, 23.5 km NNE of Mt Heywood, 33°09'S, 122°39'E, 1.xi.1990 (AD, BM, HO - paratypes).

Distribution (Map 1)

Endemic to southern part of Western Australia where it has been recorded from between 33° and 34°S and between 122° and 123°E, being north-north-east of Mt Heywood which is about 100 km NE of Esperance.



Map 1. Distribution of *D. archeri*●, *D. curva*△.

Comments

This species is named after Mr William R. Archer of WA Nurseries at Merivale who collected the type material of this species.

Generally, the flowers in this species are 5-merous but in the terminal flower of most cymes the number of calyx- and corolla-lobes and stamens are usually 4 each.

Affinities

D. archeri is nearest to *D. linearifolia* Munir in its leaves being linear, linear-oblong or sometimes linear-lanceolate, sessile, greyish-pubescent abaxially; cymes arranged in a corymbose thyrse; flowers shortly pedicellate; calyx and corolla greyish-pubescent outside; petals yellowish-white; stamens and style exserted. Nevertheless, *D. archeri* can easily be distinguished by its stem and branches being greyish-pubescent; leaves with recurved margins, glabrous adaxially, obtuse at the tip, somewhat smaller, 5 - 20 x 1 - 2 mm; flowers smaller, 2.5 - 3 mm long only; calyx and corolla more densely pubescent outside; corolla-lobes elliptic, 1.5 - 2 mm long, gradually narrowing towards the apex, not spathulate or rounded at the tip and corolla-tube densely villous inside. In *D. linearifolia*, the stem is

golden orange or somewhat rusty coloured; leaves flat with apiculate tip, greyish-puberulous adaxially, 12 - 40 x 2 - 4 mm; inflorescence somewhat lax; flowers larger, 5 - 6 mm long; corolla-lobes 2 - 2.5 mm long, more or less spathulate or with a broad rounded tip, spreading to about 8 mm diam.; corolla-tube almost glabrous or with very sparse short hairs inside.

There are several characters common between *D. archeri* and *D. parvifolia* F. Muell. In both species, the stem and branches are greyish-pubescent; leaves sessile, usually linear or linear-oblong, obtuse, with recurved margins and cymes arranged in a corymbose thyrse. However, *D. parvifolia* can easily be identified by its leaves and inflorescence being much more congested; leaves greyish-pubescent all over, sometimes ± verticillate on the main stem; primary peduncles deeply brownish-pubescent or greyish-rusty pubescent; flowers smaller than *D. archeri*, 2 - 2.5 mm long; calyx and corolla sparsely glandular but densely tomentose outside; corolla-tube shallow, hardly 0.5 mm long and ovary glandular and tomentose.

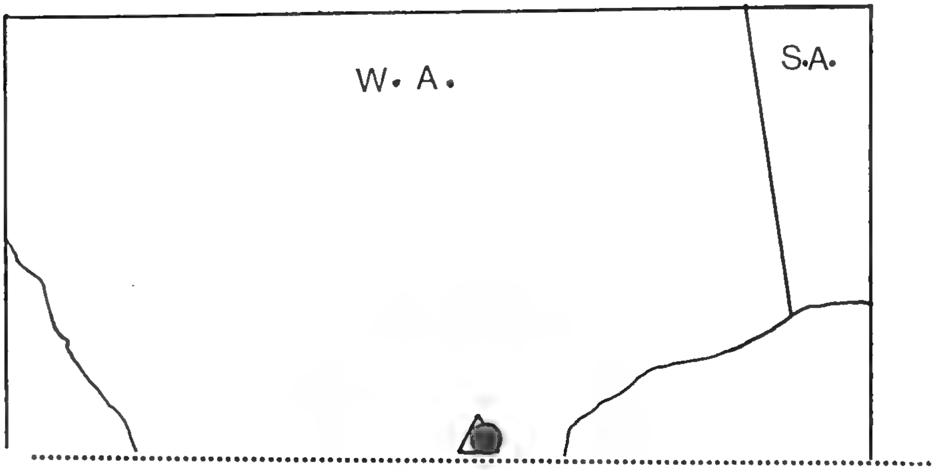
Dicrastylis capitellata Munir, sp.nov.

Frutex humilis, 20 - 25 cm altus, usque c. 100 cm diametro extendens. *Caulis* erect, prope basem ramosus: rami cylindrici, lignosi, dense

Type: *W.R. Archer 112904*, 23 km NNE Mt Heywood, 33°09'S, 122°37'E, 1.xii.1990 (AD, holotype; AD, BRI, CANB, DNA, K, MEL, NSW, PERTH —isotypes).

Description (Fig. 2)

Low shrub 20 - 25 cm high, spreading to about 100 cm diam. *Stem* erect, branched near the base; branches cylindrical, woody, densely greyish-pubescent or greyish-tomentose. *Leaves* sessile, decussate, linear to narrow linear, obtuse, with recurved-revolute margins, (4-) 6 - 15 (-20) mm long, 1 - 1.5 mm broad, puberulous-scabrous and somewhat rugulose above (adaxially), densely greyish-tomentose below (abaxially). *Inflorescence* of subglobose flower clusters (cymes) arranged into irregularly interrupted and somewhat coiled (scorpioidal) spikes. *Flower-clusters* (cymes) often sessile, sometimes shortly pedunculate, usually alternate, usually 7-flowers, 5 - 7 (-8) mm diam. at anthesis, each flower subtended by a bract; peduncles up to 3 mm long, greyish-tomentose; bracts sessile, elliptic-ovate, shorter than calyx, glandular and densely tomentose abaxially, glabrous adaxially, 2 - 3 mm long, 1 - 1.5 mm wide. *Flowers* sessile, bracteate, 4 - 4.5 mm long. *Calyx* 5-lobed, rarely 4-lobed, ± 3 mm long, glandular and tomentose outside, glabrous



CORRIGENDUM

***J.Adelaide Botanic Gardens* Volume 14 part 1**

Page 88, caption to map 1: read *D. capitellata* for *D. curva*

This species is named after Mr William R. Archer of WA Nurseries at Merivale who collected the type material of this species.

Generally, the flowers in this species are 5-merous but in the terminal flower of most cymes the number of calyx- and corolla-lobes and stamens are usually 4 each.

Affinities

D. archeri is nearest to *D. linearifolia* Munir in its leaves being linear, linear-oblong or sometimes linear-lanceolate, sessile, greyish-pubescent abaxially; cymes arranged in a corymbose thyrse; flowers shortly pedicellate; calyx and corolla greyish-pubescent outside; petals yellowish-white; stamens and style exserted. Nevertheless, *D. archeri* can easily be distinguished by its stem and branches being greyish-pubescent; leaves with recurved margins, glabrous adaxially, obtuse at the tip, somewhat smaller, 5 - 20 x 1 - 2 mm; flowers smaller, 2.5 - 3 mm long only; calyx and corolla more densely pubescent outside; corolla-lobes elliptic, 1.5 - 2 mm long, gradually narrowing towards the apex, not spathulate or rounded at the tip and corolla-tube densely villous inside. In *D. linearifolia*, the stem is

golden orange or somewhat rusty coloured; leaves flat with apiculate tip, greyish-puberulous adaxially, 12 - 40 x 2 - 4 mm; inflorescence somewhat lax; flowers larger, 5 - 6 mm long; corolla-lobes 2 - 2.5 mm long, more or less spathulate or with a broad rounded tip, spreading to about 8 mm diam.; corolla-tube almost glabrous or with very sparse short hairs inside.

There are several characters common between *D. archeri* and *D. parvifolia* F. Muell. In both species, the stem and branches are greyish-pubescent; leaves sessile, usually linear or linear-oblong, obtuse, with recurved margins and cymes arranged in a corymbose thyrse. However, *D. parvifolia* can easily be identified by its leaves and inflorescence being much more congested; leaves greyish-pubescent all over, sometimes ± verticillate on the main stem; primary peduncles deeply brownish-pubescent or greyish-rusty pubescent; flowers smaller than *D. archeri*, 2 - 2.5 mm long; calyx and corolla sparsely glandular but densely tomentose outside; corolla-tube shallow, hardly 0.5 mm long and ovary glandular and tomentose.

Dicrastylis capitellata Munir, sp.nov.

Frutex humilis, 20 - 25 cm altus, usque c. 100 cm diametro extendens. *Caulis* erect, prope basem ramosus; rami cylindrici, lignosi, dense cinerascenti-pubescentes vel cinerascenti-tomentosi. *Folia* sessilia, decussata, anguste linearia, obtusa, marginibus recurvato-revolutis, (4-) 6 - 15 (-20) mm longa, 1 - 1.5 mm lata, superne (adaxialiter) puberulo-scabra subrugulosaque, infra (abaxialiter) dense cinerascenti-tomentosa. *Inflorescentia* ex fasciculis florum (cymis) subglobosis constans in spicis irregulariter interruptis et parum circinatis (scorpiodeis) disposita. *Fasciculi florum* (cymae) saepe sessiles, interdum breviter pedunculati, plerumque alternati, plerumque floribus 7, sub anthesi 5 - 7 (-8) mm diametro, quisque flos bracto uno subtento; pedunculi usque 3 mm longi, cinerascenti-tomentosi; bracti sessiles, elliptico-ovati, quam calyce longiores, abaxialiter glandulosi et dense tomentosi, adaxialiter glabri, 2 - 3 mm longi, 1 - 1.5 mm lati. *Flores* sessiles, bracteati, 4 - 4.5 mm longi. *Calyx* 5-lobatus, raro 4-lobatus, ± 3 mm longus, extra glandulosus tomentosusque, intra glaber; lobi lanceolati vel anguste elliptico-lanceolati, 1.5 - 2 mm longi, 0.5 - 1 mm lati; tubus vadosus, ± 1 mm longus. *Corolla* diluto-caerulea vel pallido-malvina, infra tubularis, plerumque superne 4-lobata, rare 5-lobata, ± 4 mm longa, extra lobos glandulosa tomentosaque in tubo villosa et in superficie interiore loborum sparsim villosa; lobi oblongi vel elliptico-oblongi, lobus anticus quam alii aliquantum major, ± 2 mm longus, 1.5 mm latus, lobi alii aequales, 1 - 1.5 mm longi, 0.5 - 1 mm lati; tubus ± cylindricus, basi angustus, ± 1.5 mm longus. *Stamina* plerumque 4, raro 5, exserta, in fauce corollae inserta; filamenta filiformia, glabra, 1.5 - 2 mm longa; antherae 2-lobatae, dorsifixae, aliquantum oblongae, 0.5 - 1 mm longae, ± 0.5 mm latae, lobi liberi in dimidio inferiore divergentesque, longitudinaliter dehiscentes. *Ovarium* subglobosum usque obovoideum, dense tomentosum, 0.5 - 1 mm diametro, 4-loculare, ovulo uno in quoque cellula; stylus breviter exsertus, profundissime 2-ramosus, 2 - 2.5 mm longus (lobi inclusi), in dimidio inferiore dense tomentosus, superne glaber, lobi filiformes, 1 - 1.5 mm longi. *Fructus* non visus.

Type: *W.R. Archer 112904*, 23 km NNE Mt Heywood, 33°09'S, 122°37'E, 1.xii.1990 (AD, holotype; AD, BRI, CANB, DNA, K, MEL, NSW, PERTH —isotypes).

Description (Fig. 2)

Low shrub 20 - 25 cm high, spreading to about 100 cm diam. *Stem* erect, branched near the base; branches cylindrical, woody, densely greyish-pubescent or greyish-tomentose. *Leaves* sessile, decussate, linear to narrow linear, obtuse, with recurved-revolute margins, (4-) 6 - 15 (-20) mm long, 1 - 1.5 mm broad, puberulous-scabrous and somewhat rugulose above (adaxially), densely greyish-tomentose below (abaxially). *Inflorescence* of subglobose flower clusters (cymes) arranged into irregularly interrupted and somewhat coiled (scorpioidal) spikes. *Flower-clusters* (cymes) often sessile, sometimes shortly pedunculate, usually alternate, usually 7-flowers, 5 - 7 (-8) mm diam. at anthesis, each flower subtended by a bract; peduncles up to 3 mm long, greyish-tomentose; bracts sessile, elliptic-ovate, shorter than calyx, glandular and densely tomentose abaxially, glabrous adaxially, 2 - 3 mm long, 1 - 1.5 mm wide. *Flowers* sessile, bracteate, 4 - 4.5 mm long. *Calyx* 5-lobed, rarely 4-lobed, ± 3 mm long, glandular and tomentose outside, glabrous

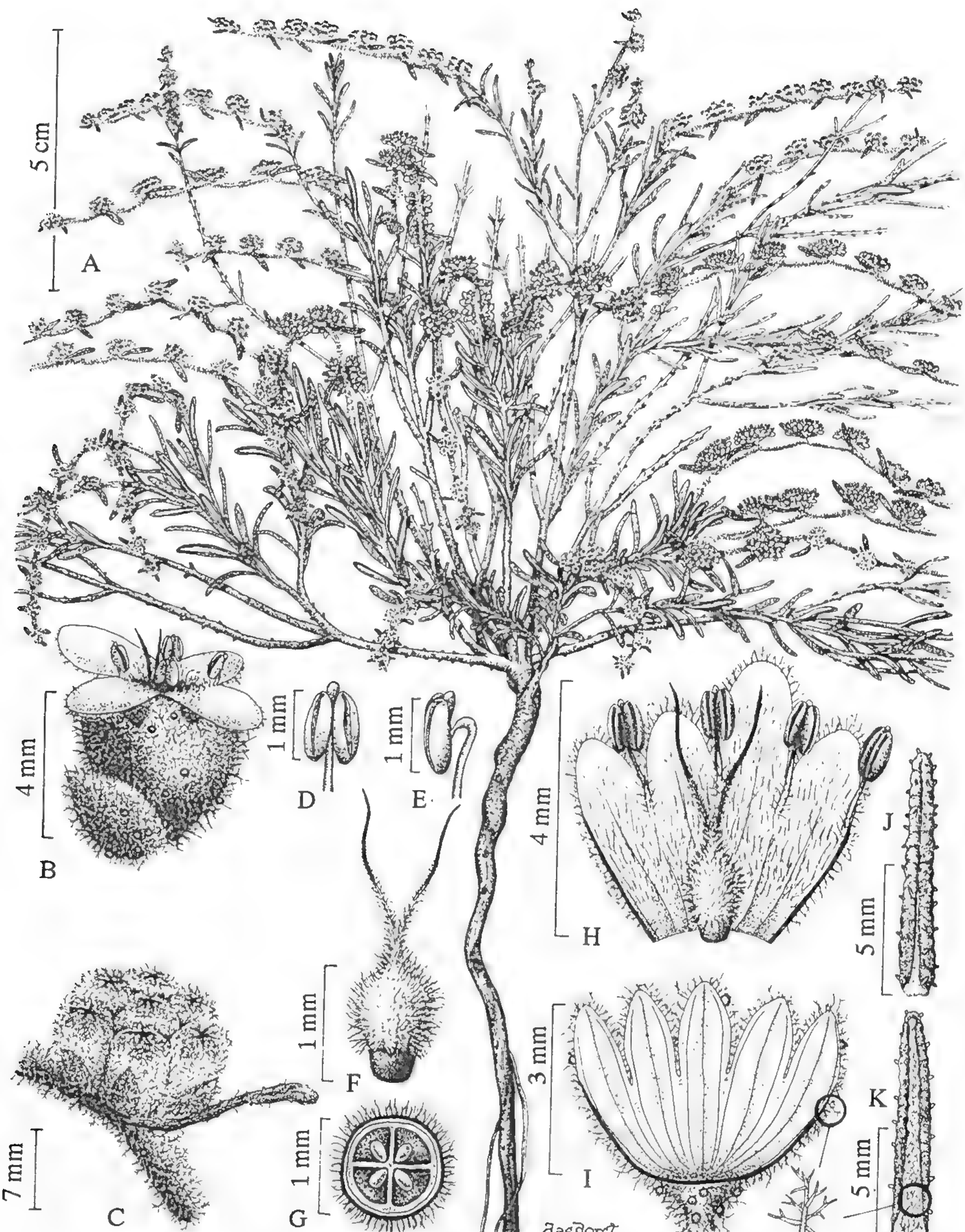


Fig. 2. *Dicrastylis capitellata* Munir (A-K, *W.R. Archer 112904*: AD, holotype). A, habit sketch; B, flowers with bract; C, cyme; D, front view of anther showing longitudinal dehiscing pore; E, side view of anther; F, gynoecium; G, transverse section of ovary; H, corolla cut open showing androecium and gynoecium; I, calyx cut open showing glabrous interior; J, leaf showing adaxial scabrous surface; K, leaf showing abaxial tomentose surface.

inside; lobes lanceolate or narrow elliptic-lanceolate, 1.5 - 2 mm long, 0.5 - 1 mm wide; tube shallow, ± 1 mm long. *Corolla* light purplish-blue or pale mauve, tubular below, usually 4-lobed, rarely 5-lobed, ± 4 mm long, glandular and tomentose outside the lobes, villous inside the tube and sparsely so on the inner face of the lobes; lobes oblong or elliptic-oblong, the anterior lobe somewhat larger than the others, ± 2 mm long, 1.5 mm wide, the other lobes equal, 1 - 1.5 mm long, 0.5 - 1 mm wide; tube ± cylindrical, narrow at the base, ± 1.5 mm long. *Stamens* usually 4, rarely 5, exserted, inserted in the corolla-throat; filaments filiform, glabrous, 1.5 - 2 mm long; anthers 2-lobed, dorsifixed, somewhat oblong, 0.5 - 1 mm long, ± 0.5 mm broad, lobes free and divergent in the lower half, longitudinally dehiscent. *Ovary* subglobose to obovoid, densely tomentose, 0.5 - 1 mm diam., 4-locular, with one ovule in each cell; style shortly exserted, very deeply 2-branched, 2 - 2.5 mm long (including lobes), densely tomentose in the lower half, glabrous above, lobes filiform, 1 - 1.5 mm long. *Fruit* not seen.

Specimens examined

AUSTRALIA: WESTERN AUSTRALIA: *W.R. Archer 112902*, 18 km N Mt Heywood, 33°11'S, 122°32'E, 11.xii.1990 (AD, paratype; L, NY —isoparatype); *W.R. Archer 112904*, 23 km NNE Mt Heywood, 33° 09'S, 122° 37'E, 1.xii.1990 (AD, holotype; AD, BRI, CANB, DNA, K, MEL, NSW, PERTH —isotypes).

Distribution (Map 1)

Endemic to southern part of Western Australia where it has been recorded from between 33° and 34°S and between 122° and 123°E, being north and north-east of Mt Heywood which is about 100 km NE of Esperance.

Comments

The specific epithet of this species is proposed after its small flower-heads along the terminal axis. In each flower-head, the peripheral flowers are found to open ("mature") before the central (terminal) flower. The known distribution range of *D. capitellata* seems to be similar to that of *D. archeri.*

Affinities

D. capitellata seems to be nearest to *D. lewellinii* (F. Muell.)F. Muell. in its flowers being arranged into subglobose clusters (cymes) along terminal axis; leaves sessile, linear, with recurved margins; flower-clusters (cymes) 7-flowered each; calyx and corolla tomentose outside; corolla purplish-blue, lobes entire, the anterior lobe larger than the others; stamens and style exserted; stamens usually 4 in each flower. Nevertheless, *D. capitellata* may easily be distinguished by its leaves being mostly opposite, puberulous-scabrous above (adaxially), 1 - 1.5 mm broad; flower-clusters (cymes) smaller, 5 - 7 (-8) mm diam. at anthesis, alternate, usually sessile; bracts smaller, 2 - 3 mm long; flowers 4 - 4.5 mm long; calyx and corolla respectively ± 3 mm and 4 mm long; corolla usually 4-lobed; calyx-lobes not tomentose inside; filaments and anthers respectively 1.5 - 2 mm and ± 0.5 mm long and style 2 - 2.5 mm long. In *D. lewellinii*, the leaves are mostly in whorls of 3, greyish-tomentose all over, 2 - 6 mm broad; flower-clusters (cymes) 7 - 15 mm diam. at anthesis, the lower clusters sometimes with a peduncle of up to 5 mm long; bracts larger, 3 - 3.5 mm long; flowers 8 - 9 mm long; calyx and corolla respectively 5 - 6 mm and 7 - 8.5 mm long; calyx-lobes tomentose on the upper half inside; filaments and style respectively 3.5 - 4 mm and 6 - 7 mm long. Moreover, *D. lewellinii* occurs in all mainland states except Western Australia, while *D. capitellata* is endemic to southern part of Western Australia.

There are several characters common between *D. capitellata* and *D. microphylla* Munir. Both have subglobose sessile flower-clusters (cymes) each comprising 7-flowers, calyx and corolla tomentose outside, corolla mauve and villous inside the tube and stamens and style exserted. However, *D. microphylla* can readily be identified by its densely tomentose stem and leaves, very woolly flower-clusters (cymes) which are always opposite along the slender purple peduncle, larger flowers and flower-bracts. Moreover, the number of calyx- and corolla-lobes and stamens are 5 each in a flower.

There are some characters common between *D. capitellata* and *D. nicholasii* F. Muell. The shape and average leaf-size and subglobose flower-clusters (cymes) are similar in both species. Nevertheless, the flower-clusters (cymes) in *D. nicholasii* are always on a distinct peduncle of 15 - 25 mm long, flowers 5-merous and longer than *D. capitellata*.

Acknowledgements

The author is grateful to Dr J.P. Jessop for translating into Latin the description of both new species; Mr G.R.M. Dashorst for preparing the illustrations; Miss M. Eadsforth for typing the manuscript.

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THE GENUS *PLEUROCARPAEA* BENTH. (ASTERACEAE: VERNONIEAE)

C.R. Dunlop

Northern Territory Herbarium, Conservation Commission
of the Northern Territory,
P.O. Box 496, Palmerston, Northern Territory, 0831

Abstract

Pleurocarpaea Benth., an endemic genus of the Australian tropics is revised. One new species, *P. fasciculata* Dunlop, a second for the genus, is described and illustrated. Distribution maps are provided for both species.

Introduction

Pleurocarpaea was described by Bentham (1867a) with a single species, *P. denticulata*, based on a Robert Brown collection from Arnhem Bay in the Northern Territory. The species has since been collected in the Kimberley, Western Australia and northern Queensland. A second species, described here, was discovered in 1972; it is known only from a handful of populations in Arnhem Land, Northern Territory.

When describing *Pleurocarpaea*, Bentham (1867a) remarked that it appeared to have no close relatives in Vernonieae though in a later article (Bentham, 1867b) he suggested an affinity with sections of *Vernonia* through the shortly apiculate auricles of the anther bases. The genus however, though possessing all the essential characters of Vernonieae (Jones, 1977), is readily distinguished from other members of the tribe. Features common to the two species which in combination might be regarded as characterising the genus are greatly exserted florets, a vestiture of translucent glands and a variable, often rudimentary, pappus.

Pleurocarpaea is the only Australian endemic genus in the Vernonieae (Jones, 1977). The generic key of Bentham (1867a) still serves to distinguish the Australian members of the tribe.

PLEUROCARPAEA Benth.

Pleurocarpaea Benth., Fl. Aust. 3: 460 (1867).

Type: *P. denticulata* Benth.

Shrubs or perennial suffruticose *herbs*. Vegetative parts punctate with translucent, minutely stipitate glands which appear sessile; indumentum usually sparse, of appressed thin-walled 2-armed hairs and minute hairs with a short erect stipe and an inflated thin-walled terminal cell. *Leaves* alternate, sessile or shortly petiolate. *Capitula* solitary or loosely corymbose, homogamous; *phyllaries* foliaceous, in 2 or 3 series, imbricate, glandular, glabrescent. *Receptacle* flat, naked or more usually paleaceous; paleae exceeding the achenes, lanceolate to linear, acute to acuminate, similar to the phyllaries in colour, texture and vestiture . *Florets* bisexual, fertile; corollas purple, pink or white, exceeding the involucre by more than half their length, campanulate, 5-lobed, the lobes ± half the corolla length, glandular, glabrescent; stamens inserted just below the limb, sagittate, the auricles acute, distal appendage acute; style branches tapered, acute, shortly hairy. *Achenes* prominently ± 10-ribbed, glandular. *Pappus* absent or of persistent bristles either scattered or cohering in a continuous ring.

Distribution

Tropical Australia north of 16° South.

Key to the species

Stems annual; leaves 5-50 mm wide; capitula 8-18 mm long .... 1. *P. denticulata*
Stems perennial; leaves 2-7 mm wide; capitula 6.4-8 mm long .... 2. *P. fasciculata*

1. **P. denticulata** Benth., Fl. Aust. 3: 460 (1867); Benth., Hooker's Icon. Pl. 11: 5, t. 1006 (1867).

Type: Mallinson's Is. Arnhem Bay, *R. Brown* (labelled *F. Bauer*), 1.iii.1803 (lecto: (designated here):K; photo, DNA; isolecto.: BM, CANB, K, MEL, NSW).

Description

Perennial suffruticose *herbs* with annual aerial stems, to 80 cm high. Stems and leaves glabrescent or glabrous, rarely the young leaves tomentose. *Stems* erect or decumbent, usually several together; striate to angular, rarely smooth. *Leaves* ovate, elliptic or narrowly elliptic, 20 - 85 mm long, 5 - 50 mm wide, irregularly dentate to denticulate or entire, obtuse or acute. *Peduncles* naked, leafy or bracteate, to 150 mm long. *Capitula* 8 - 18 mm long; *phyllaries* linear-lanceolate or broadly lanceolate or ovate, entire or rarely with one or two coarse teeth, 5 - 9 mm long, acute, acuminate, or rarely cuspidate, the series ± equal in length or the outer shorter. *Receptacle* to 7 mm wide, glabrous, paleaceous. *Florets* 15 - 70; corollas purple, pink or white, 6 - 9 mm long; anthers 2.5 - 3.9 mm long. *Achenes* cylindrical to fusiform, truncate, crowned by the persistent annular style base, pubescent to glabrescent, 3.5 - 5 mm long. *Pappus* absent or of 1 - 10 smooth or glandular hairy bristles to 1 mm long or bristles minute in a continuous ring.

Distribution

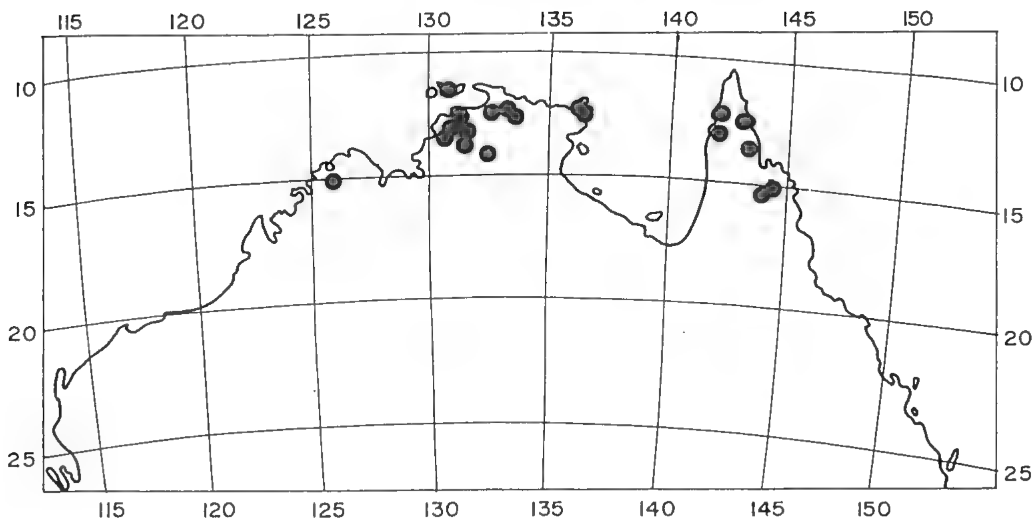
Northern Territory, Queensland, Western Australia. Map 1.

Selection of specimens examined

NORTHERN TERRITORY: Darwin, *F.A.K. Bleeser s.n.*, iv.1927 (NSW); Daly R. road, *N. Byrnes 1243*, 19.xii.1968 (DNA, NT); East Alligator R., *C.R. Dunlop 3335*, 23.ii.1973 (AD, BRI, CANB, DNA, K, L, MEL, MO, NT, NSW); Batchelor, *G.F. Hill 52*, 17.vii.1913 (MEL).

QUEENSLAND: N of Laura R., *N. Byrnes 3331*, 16.v.1975 (BRI, QRS); West bank of Jedda Ck., *J.R. Clarkson 4203*, 23.xii.1981 (QRS); between Massy Ck. and Rocky R., *B. Hyland 10301*, 20.ii.1980 (BRI, QRS); 23.5 km ENE of Weipa Mission, *R.L. Specht & R.B. Salt 195*, 9.xii.1974 (BRI).

WESTERN AUSTRALIA: West Kimberley, *F.M. House s.n.*, 1901 (PERTH); Mitchell Plateau, *K.F. Kenneally 5331A*, 24.vi.1976 (CANB, PERTH).



Map 1. Distribution of *P. denticulata.*

Typification

With the original description Bentham made the following comment: "The plant is only known from Brown's specimens, one of which, with the tracing of a drawing by Bauer, was given to me in Vienna in 1837, and which I have since seen others in Brown's herbarium." A sheet at K, marked "Herbarium Benthamianum" and with sketches of floral parts later used in Bentham's article, is evidently that referred to by Bentham in the above quotation. The specimen in question is labelled "Australia F. Bauer" but it must be assumed from the foregoing that it is part of Brown's material from Mallinson's Island. This sheet is one of two of Brown's at K; as the probable subject for Bentham's description it is selected as the lectotype.

Notes

A species of seasonally wet woodland or open woodland habitats which are subject to burning during the dry season. The plants reshoot from the stem base in the late dry season or early wet (September - December), flowering and setting fruit before the end of the wet (March - April).

Flower colour is variable. Specimens from north Queensland generally are white flowered while those from the Northern Territory are more frequently purple or pink with odd occurrences of white.

Bentham noted in his original description that the pappus bristles were deciduous. In fact in many plants the bristles are entirely absent; when they are present they appear to be persistent as they can be seen on the mature fruit. This condition applies to both species. Bentham also described the receptacle as naked. Paleae however are usually present and quite obvious, greatly exceeding the achenes.

Domin (1929) lists *Lipothrix denticulata* R.Br. ex Benth. as a synonym of *Pleurocarpaea denticulata* Benth. This is an error. *Lipothrix denticulata*, a manuscript name of Brown's, was mentioned by Bentham to point out that Brown had used the generic name elsewhere for another taxon. The combination cannot be regarded as being validly published.

2. **P. fasciculata** Dunlop, sp. nov.,
a *P. denticulata* Benth. habitu ligneo, capitulis parvis foliis fasciculatis, et characteribus aliis differt.

Frutex sempervirens ad 1 m altus. Caules et folia glabra vel glabrata, plerumque tomento persistent albido in axillis et in gemmis axillaribus. *Caules* erecti, striati; rami breves laterales spinescentes. *Folia* caulium principalium late disposita, fasciculata in surculis brevibus axillaribus, anguste lanceolata, anguste oblanceolata vel anguste elliptica, acuta, 10 - 35 mm longa, 2 - 7 mm lata, integra vel dentes minutos unos ad aliquot habentes, distantes. *Pedunculi* bracteati, ad 40 mm longi. *Capitula* 6.4 - 8 mm longa; *phyllaria* lineari-lanceolata ad late lanceolata, acuta, acuminata vel cuspidata; externa saepe ciliata, 2 - 3 mm longa, intima 4 - 5 mm, raro longiora. *Receptaculum* c. 1 mm latum, tomentosum, nudum vel 1 - 3 paleas habens. *Flosculi* 4 - 7; corollae albae, 4.5 - 5.4 mm longae; antherae 2.5 - 3 mm longae. *Achenia* oblonga-obovata, leviter compressa, costis colliculosis, trans apicem extensis, et cavitas annularis facientibus, dense tomentosa, 2.5 - 4 mm longa. *Pappus* absens vel constans unae ad aliquot setarae glabrae vel pubescentes, ad 1 mm longas.

Type: 45 km SE of Ramingining, Arnhem Land, 12° 39'S, 135° 19'E, *C.R. Dunlop 8481 & N.G. White*, 18.vi.1989 (holo.: CANB; iso.: AD, BRI, DNA, K, L, MEL, MO, NSW, PERTH).

Evergreen *shrub* to 1 m high; stems and leaves glabrous or glabrescent, often with a persistent whitish tomentum in the axils and on axillary buds. *Stems* erect, striate; the short lateral branches spinescent. *Leaves* widely spaced on main stems, clustered on short axillary shoots; narrow-lanceolate, -oblanceolate or -elliptic, 10 - 35 mm long, 2 - 7 mm wide, entire or with one to several minute distant teeth, acute. *Peduncles* bracteate, to 40 mm long. *Capitula* 6.4 - 8 mm long; *phyllaries* linear-lanceolate to broadly lanceolate, outer often ciliate, 2 - 3 mm long, inner 4 - 5 mm, rarely longer, acute, acuminate or cuspidate. *Receptacle* c. 1 mm wide, tomentose, naked or with 1 - 3 paleae. *Florets* 4 - 7; corollas white, 4.5 - 5.4 mm long; anthers 2.5 - 3 mm long. *Achenes* oblong-obovoid, slightly compressed, ribs colliculate and extending beyond the apex to form an open cavity, densely tomentose, 2.5 - 4 mm long. *Pappus* absent or of 1 to several glabrous or hairy bristles to 1 mm long. Fig. 1.

Distribution

Arnhem Land, Northern Territory. Map 2.

Other specimens examined

NORTHERN TERRITORY: Goyder R., *C.R. Dunlop 8678 & N.G. White*, 26.vi.1990 (AD, CANB, DNA, MEL); 5 miles E of Goyder R. crossing, *P.K. Latz 2818*, 17.vi.1972 (DNA, NT); 18 miles NE Wilton R., Bulman Crossing. *J.R. Maconochie 1449*, 15.vi.1972 (BRI, CANB, NT); Groote Eylandt, *J. Waddy 500*, 4.iii.1976 (DNA); Groote Eylandt, *J. Waddy 620*, 11.i.1977 (DNA); Groote Eylandt, *J. Waddy s.n.*, 5.iv.1977 (DNA, K, MEL, NSW).

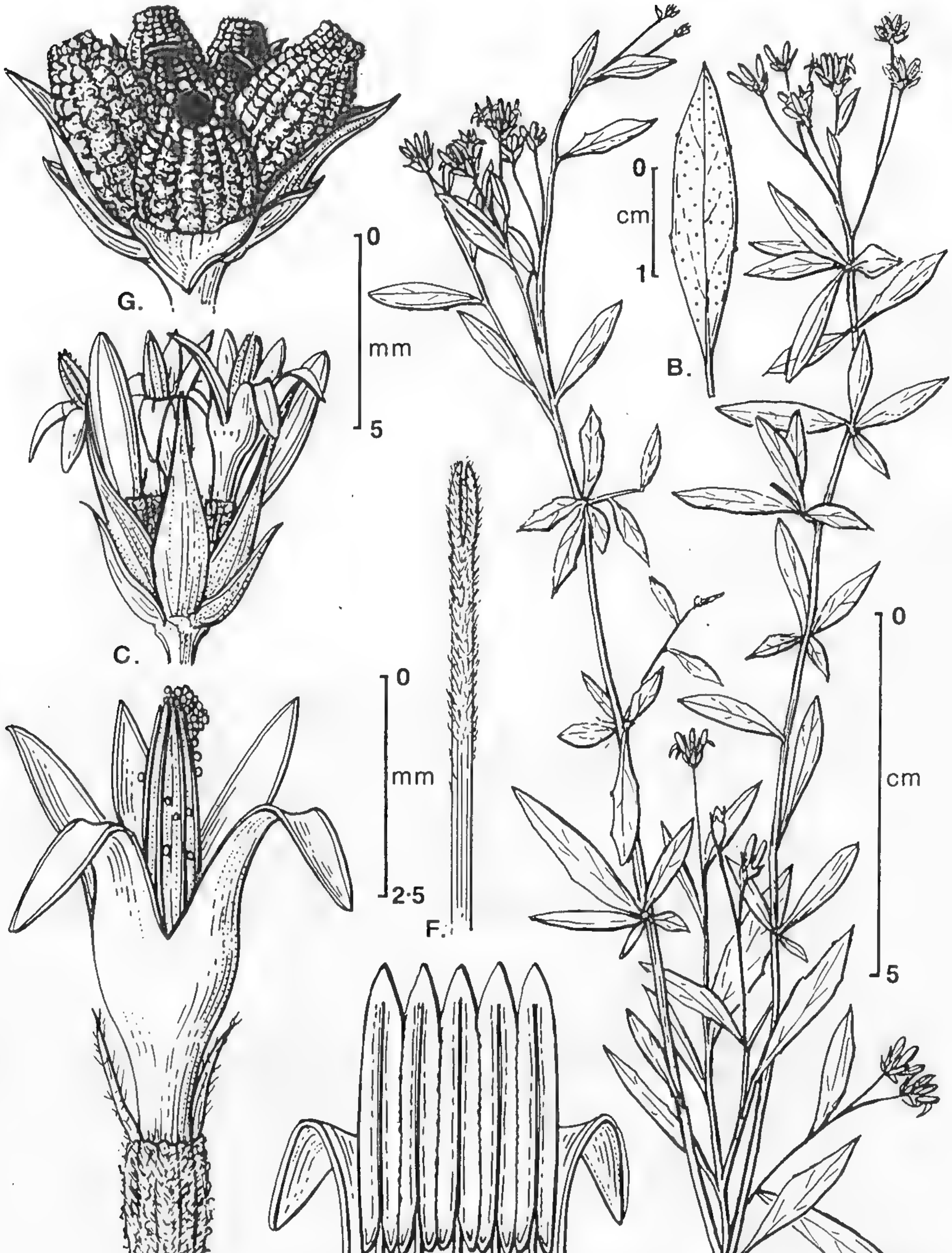
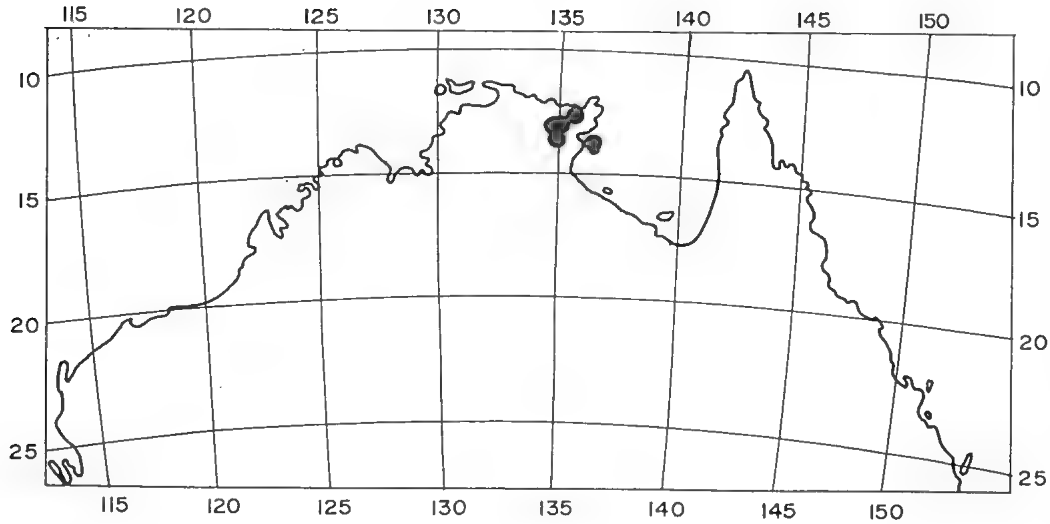


Plate 1. *Pleurocarpaea fasciculata.* A, flowering branch; B, leaf; C, capitulum; D, floret; E, stamens; F, style. All from *C.R. Dunlop 8481.*



Map 2. Distribution of *P. fasciculata*

Notes

P. fasciculata usually grows in discrete colonies in run-on areas which are waterlogged during the Wet season and which remain moist, at least at depth, for much of the Dry season. These habitats, which frequently support an overstorey of *Melaleuca* spp., have a sparse grass cover and are rarely burnt. Flowering material has been collected from January to June.

Conservation status

On the basis of current records, a coding of 3R (Briggs & Leigh, 1989) would be appropriate for this species.

Acknowledgements

Directors/Curators of the following institutions are thanked for the loan of specimens: AD, BRI, CANB, MEL, NSW, PERTH. The Keeper, K, kindly provided cibachromes of type specimens; the assistance of Dr Greg Leach (Australian Botanical Liaison Officer, 1990-91) in obtaining these prints is much appreciated. Milton Andrews is thanked for the fine illustration. Help from Ms Julie Waddy of Groote Eylandt for collecting extra material of the new species and from John Clarkson of Mareeba for advice on flower colour in Queensland populations of *P. denticulata* is gratefully acknowledged.

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DROSERA PRAEFOLIA TEPPER: A SPECIES ENDEMIC TO SOUTH AUSTRALIA

R. Bates

c/- State Herbarium, Botanic Garden, North Terrace,
Adelaide, South Australia 5000

Abstract

Drosera praefolia Tepper is reinstated as a species endemic to the Mt Lofty Ranges and Kangaroo Island of South Australia. A lectotype is selected, and an amplified description provided together with a table comparing *D. praefolia* and *D. whittakeri* Planchon. Some historical information and details of the biology of *D. praefolia* are included.

Introduction

Drosera praefolia was described by J.G.O. (Otto) Tepper (1892) in *Botanisches Centralblatt* 50:357. Tepper sent material to Mueller in Melbourne in 1882 "with the hope that that gentleman might describe it", but Mueller did not as the material was "insufficient". Tepper had been living at Clarendon in 1882 but by 1892 he resided at Norwood. In April 1892 he obtained more material from Clarendon and completed a detailed description and illustrations. He had however made drawings, notes and observations on the life cycle of *D. praefolia* since 1882. His 1892 paper was amazingly detailed for a 19th century taxonomic paper and shows that Tepper was a very observant naturalist, and how unusual a species *D. praefolia* is. The information he gave does not appear to have been used by later workers (Black 1924, Marchant 1986). Tepper's description of *D. praefolia* separated it from *Drosera whittakeri* on the basis of its flowering in the autumn before the leaves appear, of its *lateral* not terminal scapes, of the *white* tuber and *scaly* stolon and clearly showed that it is not a form of *D. whittakeri*. Yet Black (1924) reduced the taxon to *D. whittakeri* var. *praefolia* without comment, and Marchant and George (1982) treated it as a synonym of that species. Marchant (1986) stated that it was regarded as a 'precocious variant of *D. whittakeri*', while other workers, e.g. Prescott (1989) do not mention *D. praefolia*. Local naturalists, however, have recognised it and the 'Friends of Onkaparinga Park' depict the species on the cover of their 1989 brochure as "*Drosera praefolia* (Sundew)".

Lectotype (chosen here): Clarendon, grassy hillsides in very dry soils, 7 April 1882, *Tepper 618* (lecto: MEL); Clarendon, May 1882, *Tepper s.n.* (syn: AD). Both collections bear Tepper's labels with his manuscript name '*D. aphylla*'. His illustrations (p. 356) were based partly on the lectotype and partly on the syntype. His description was based on these collections and a further collection made in the same area in April 1892 (not found). Since no mention of a specimen collected in May 1882 is made in the protologue, the one collected on 7 April 1882 is selected as lectotype.

Drosera praefolia	*Drosera whittakeri*
Vegetative	
Tuber white, starchy.	Tuber red, fleshy.
Stolon invested with many lanceolate, glabrous, scales.	Stolon without scales.
Leaf rosette appearing after flowering, quite prostrate.	Rosette appearing after flowering, prostrate or not.
Leaves petiolate.	Leaves sessile.
Petiole not ribbed, with a few gland tipped hairs.	Flattened leaf base with 3-7 longitudinal ribs, eglandular.
Leaf lower surface with distinct red veining, one broad major vein and strong reticulate veins.	Leaf lower surface with indistinct veining, 3 major veins and weaker reticulate ones.
Leaf green above with contrasting broad red central stripe.	Leaf green or suffused red or wholly red, not striped.
Floral	
Flowers Feb. - April (before leaf rosette appears).	Flowers May - Dec. (after rosette appears).
Scape less than 0.4 mm diam., arising from the stolon (lateral).	Scape more than 0.4 mm diam. arising from centre of leaf rosette (apical).
Calyx segments 4-5 mm long, conjoined in basal 0.5 mm, not enlarging after flowering.	Calyx segments 5-6 mm long, free except at very base, enlarging after flowering.
Petals oblong, 6-9 mm long, 4-5 mm wide.	Petals obovate, 10-12 mm long, 6-10 mm wide.
Styles dichotomously branched.	Styles divided into many filiform segments.

Table 1: Comparative analysis of characteristics of *D. praefolia* and *D. whittakeri*.

Description

Tuber white, globose, c. 6 cm diam., starchy, and covered by black brittle tunicate sheaths. *Stolon* vertical, 2-6 cm long, white, with several ovate-lanceolate acute glabrous scale leaves 1-8 mm long, lower ones pale, upper ones greenish with red margins, roots at flowering short but elongating to 1-2 cm long. *Leaves* absent at flowering, later 5-10 in a prostrate basal rosette; petiole slender, red, 4-10 x 2-3 mm, not ribbed, margins upturned; lamina ovate, 9-20 x 7-10 mm, below glabrous, with one broad red main vein and distinct red lateral reticulate veining, above glandular hairy, with numerous pale curved uniform hairs topped with spherical bright red glands extending onto petiole, green with red

longitudinal stripe extending from the petiole almost to the apex, margins slightly denticulate with each tooth ending in a gland-tipped hair similar to those on the lamina. *Scapes* 1-many, 2-4 cm long, filiform, precocious, arising laterally from top of rhizome, sometimes connate basally so as to form an umbel. *Flowers* delicate, short-lived, usually opening singly. *Calyx* 4-6 mm long, punctulate, connate in basal 0.5 mm, lobes reddish or green, acute, not enlarging significantly after flowering. *Petals* white, oblong, shallowly notched, 6-9 x 4-5 mm, widely expanded. *Stamens* 5, filaments 2 mm long, anthers yellow. *Styles* 3, dichotomously branched. *Capsule* ovoid, to 3 mm long. *Seeds* 3-9, subcylindric, to 1 mm x 0.6 mm, often abortive, black and glossy, pitted one end, apiculate the other.

Distribution (Map 1)

Endemic to south-central South Australia in an arc from near Adelaide along the western flanks of the southern Mt Lofty Ranges to Kangaroo Island, usually in dry exposed sites in compacted clay-sand over laterite, or in lateritic gravel in low woodland associated with *Eucalyptus fasciculosa, Acacia paradoxa, Allocasuarina verticillata, Xanthorrhoea semiplana*. Often on exposed ridge tops but extending almost to sea level. Commonly with other *Droseras* including *D. whittakeri*.

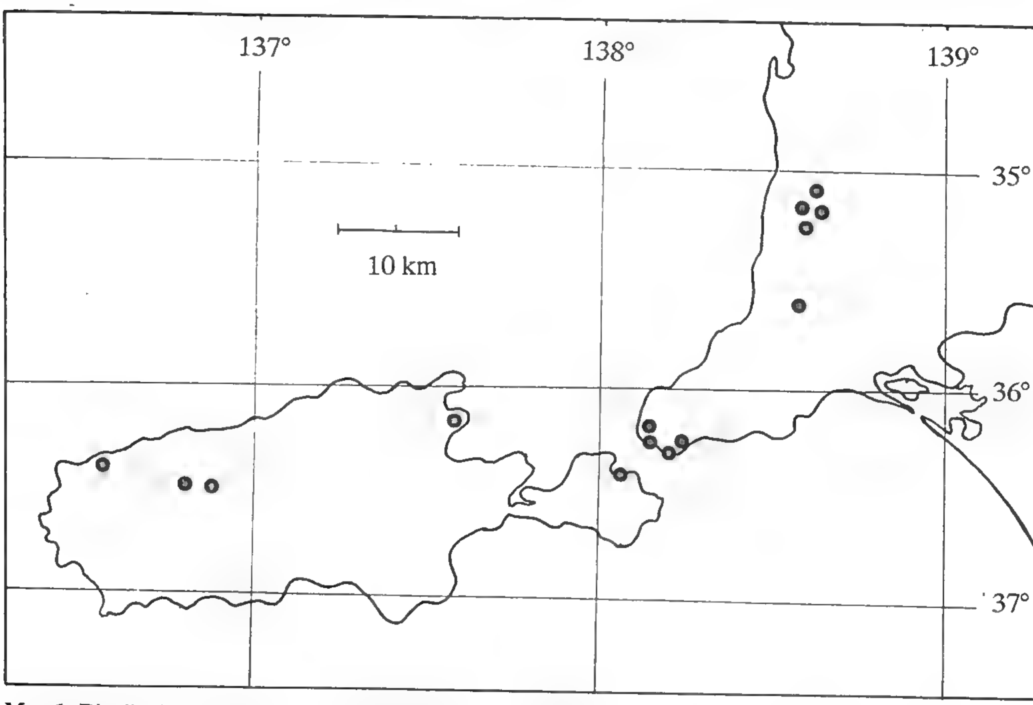
Flowering March - May, always before the leaf rosette is produced. Sweetly fragrant and visited by native bees, wasps and flies which are the chief pollinators.

Biology

The flowers of *D. praefolia* emerge from the ground one to two weeks after the first cold showers of the autumn. Heavy rain is not required; flowers have appeared after as little as 10 mm in the six weeks prior to their emergence. The extreme dry conditions of December - June 1990 did not appear to affect flowering time, size or number of flowers as some plants in the driest sites produced 10 or more flowers and released seed before the emergence of a single leaf. Flowers open singly or sometimes two together and last only two or three days so that there is a succession of flowers over a period of 2 - 21 days. Both native bees and flies have been seen to visit the perfumed and showy, glistening-white flowers which face distinctly upwards and expand widely in warm sunshine. At first the scape is erect, only 1-2 cm long but after flowering it elongates and becomes procumbent so that the seed capsule is placed on the ground. Many flowers do not set seed; in those that do develop seed, only a few of the seeds in the capsule mature, so that there are seeds of a varying size. The capsule matures about 4 weeks after flowering with seed usually released in May - June. The habit of *D. praefolia* of placing its seed capsules on the ground does not encourage wide dispersal.

The leaves appear only after good rains. In a wet autumn this may be only a week after flowering but in dry times may be 3 - 6 weeks later so that occasionally, as in 1990, seed is released before the leaves appear. The leaves are appressed to the ground soon after emergence even in shady sites so that the rosettes are always prostrate. The leaf rosette begins to die off in September and completely senesces with the advent of hot weather usually by mid-October. Roots are small for the size of the plant and in addition to the extra nutrients obtained through digestion of insects trapped by the sticky hairs on the leaves, a mycorrhizal association with soil fungi is likely. Fire or other disturbance is not required to facilitate flowering, but flowering is more profuse after bushfires. Plants usually form small loosely packed colonies. My observations agree completely with those of Tepper (1892) who devotes a good deal of space to the subject.

Although *D. praefolia* favours bare ground it still flowers under dense thickets of *Acacia paradoxa* at Sundews Lookout (overlooking the deep gorge of the Onkaparinga River). Near Cape Jervis plants occur in exposed sites overlooking the sea and are subjected to buffeting gales.



Map 1: Distribution of *Drosera praefolia* Tepper from collections at AD.

Collections examined:

AUSTRALIA: SOUTH AUSTRALIA: Southern Lofty: Deep Creek Cons. Park, Tapanappa, 3.iii.1990, *R. Bates 22149*; Piggott Range Rd, 30.iii.1983, *R. Bates s.n.* (flowering '2 weeks after heavy rain'); 2 km E of Cape Jervis, on dry grazed hills, also Talisker and Deep Creek Cons. Park, 10.iv.1989, *R. Bates 17555*; Onkaparinga Gorge Rec. Park, 25.v.1990, *R. Bates 23135*; Cherry Gardens, 10.iv.1910, *J.M. Black s.n.*; 5 km W Clarendon, 9.iv.1967, *R. Nash s.n.*; Onkaparinga Gorge Rec. Park NW corner over ironstone, 29.iv.1990, *E.L. Robertson s.n.*; 1½ km SW Cherry Gardens, 28.iv.1967, *T.J. Smith s.n.*; Scrubland at Cherry Gardens, 28.iv.1972, *T.J. Smith 1856*. Kangaroo Island: Old cemetery paddock Kingscote in clay soil, 10.v.1969, *G. Jackson 614, 615*; Gosse lands, 4 km S of Playford Highway in lateritic sand, 12.iv.1982, *G. Jackson 1516*; Rex Ellis property, Hundred of Borda, on camel track, 26.iv.1982, *G. Jackson 1522*.

Conservation status: Common and well conserved within its limited distribution.

References

Black, J.M. (1924). 'Flora of South Australia'. 258. (Govt Printer: Adelaide).

Marchant, N.G. & George, A.S. (1982). Flora of Australia, 8: 51. (Australian Govt. Publishing Services: Canberra).

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Tepper, J.G.O. (1895). Bot.Centralbl. 53: 9.

J. Adelaide Bot. Gard. 14(1): 103-104 (1991)

BOOK REVIEWS

The Concise Flora of Singapore — Gymnosperms & Dicotyledons. Hsuan Keng (1990). pp. 222, 460 illustrations. (Singapore University Press). Softbound.

This is the first attempt since Ridley in 1900, to produce a flora exclusively of Singapore. Due to it's location at the bottom of the Malay Peninsula, the flora of Singapore is virtually an extension of that of the Peninsula with, as Keng states, only a few endemic species. In recent times the flora has been covered by revisionary work for the Flora Malesiana, however many families are still to be completed for this work.

The "Flora" features brief descriptions of both the native and introduced plants of Singapore, the two categories being distinguished at a glance as names of native plants are printed in boldface and those of introduced plants in italics. Keys are provided at the family and generic levels. Keys to the species are probably unnecessary in a concise work of this kind, due to the limited number occurring in each genus. The inclusion of line drawings, with some representatives from nearly all families, is a very useful part of the book. Unfortunately in some cases the drawings are inadequate and have limited value as an identification aid. A list of the illustrations is included in the front of the book, ordered by number corresponding to family and sequence within the family. It would have been more useful had this list been arranged alphabetically, and also to indicate within the text of a species, if that species was illustrated. In a concise flora, the emphasis must be on saving space, however the inclusion of such information would be of greater value than for instance, the inclusion of cited specimens.

While an index is included, it is only to families and genera. The extension of the index to include species and also common names (which are included in the text) would have made the work that much more valuable.

Distribution is given for each species — for native Singaporean species distribution is listed by area within Singapore itself, however distribution outside of Singapore is not given. It would also have been useful to include a map with at least some of the Singaporean areas marked. The distribution of introduced species is given in brief, and may at times be incomplete e.g. *Melia azedarach* is listed as being native to Northern India, whereas its true range extends to Northern Australia.

The text is well presented even though some mistakes were obvious e.g. the use of a comma instead of a fullstop after a generic abbreviation, and the consistent misspelling of *Datura metel* (misspelt *D. metal*). An unnecessary abbreviation throughout is the shortening of the generic name to a few letters, rather the usual single letter.

Overall this is a very worthwhile addition to the Flora treatments of the region, in particular as it incorporates naturalized and cultivated species as well as those native. Many native species have disappeared from the island due to increasing population and development pressures, to the point where the introduced species are a major component of the current flora. The books value lies in its conciseness and the number of illustrations included. It should be of considerable use both to those working directly with the islands flora and to those dealing with plants of the region from a more general viewpoint.

T.J. Christensen
Adelaide Botanic Gardens

A Key to Australian Grasses. Simon, B.K. (1990). pp. 150. (Queensland Department of Primary Industry: Brisbane). Softbound. $A39.00, incl. postage.

"This book contains the first complete set of keys for the identification of Australian grasses since the 1878 Flora of Australia".

To prepare keys to 1319 grasses is a daunting job. Simon has attempted this by presenting a key to genera which are then arranged alphabetically and under each genus is a key to the species. Critical, but not exhaustive, references are provided under each genus as well as an indication of the States from which the species has been recorded.

The author writes of a "continually updated computerised database of taxonomic and distributional information" but it is not stated explicitly whether the keys were generated by the computer or derived 'by hand' from the database.

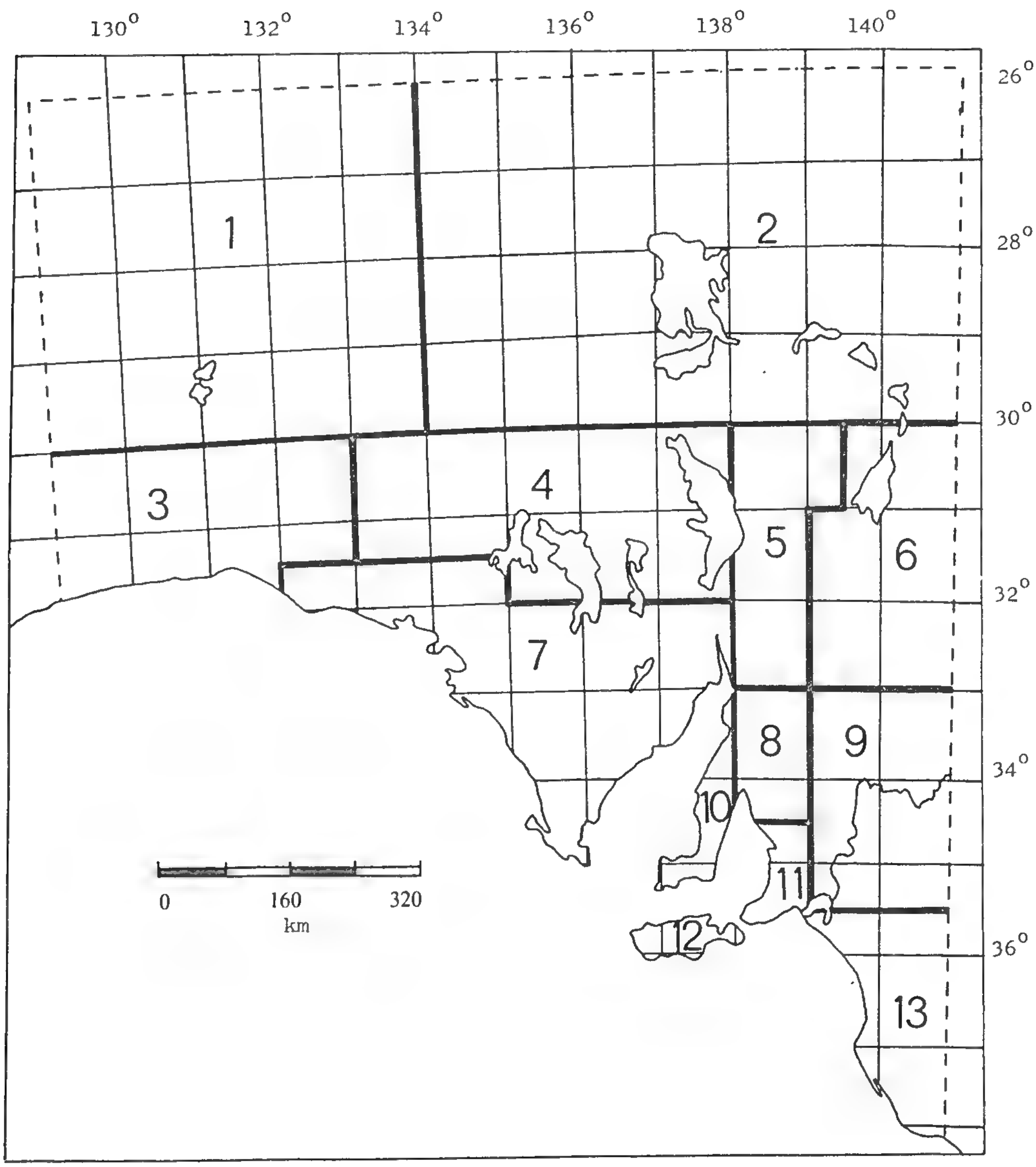
Simon has presented an austere set of keys with minimal and one hopes effective leads. Since the sole objective of the keys is to reach a name without error I cannot see why useful additional characters or comment could not be added in many cases, after all there is space in almost every lead. It was disconcerting to be side tracked at the very first lead: "Culms woody" does not lead to *Arundo*! If it is not convenient to key it out there why not state 'see also *Arundo* or similar', there is plenty of space. In general Simon does provide measurements with many of his lead characters and relatively few are subjective e.g. "Leaves very fine" v. "Leaves coarse". Despite these relatively minor short comings it should be useful especially in those States still without regional floras.

The impetus given to both plant collecting and taxonomic work in Australia by the Flora of Australia has resulted in a great many additions to our flora. Simon is to be commended for his efforts to keep us updated with his "Checklist of Australian Grasses" and now a key to help us find our way amongst them.

David E. Symon
State Herbarium of South Australia

REGIONS OF SOUTH AUSTRALIA ADOPTED BY THE STATE HERBARIUM — ADELAIDE

1. North-western
2. Lake Eyre
3. Nullarbor
4. Gairdner-Torrens
5. Flinders Ranges
6. Eastern
7. Eyre Peninsula
8. Northern Lofty
9. Murray
10. Yorke Peninsula
11. Southern Lofty
12. Kangaroo Island
13. South-eastern



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Papers will be accepted in the following categories:

(a) Plant systematics (Australian and horticultural groups); (b) Descriptive plant morphology, anatomy and ecology; (c) Obituaries, biography and history; (d) Bibliographic studies, book reviews; (e) Botanical illustrations; (f) Noteworthy horticultural contributions. Preference will be given to unpublished material of suitable standard not intended for publication elsewhere.

Copy

Manuscripts must be typed, with double spacing and margins at least 3 cm wide, on one side of the paper only. Three copies must be submitted. Captions must not be italicized, underlined or typed in capitals. All scientific names of generic or lower rank must be underlined.

The print area for illustrations is 18 x 13 cm (excluding captions). Half-tone material should be submitted this size if possible, but will be reduced by the printers, if necessary.

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The pattern of the paper should generally be:

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References

Text references to publications should be indicated as follows: (Smith, 1959), (Smith, 1959, p. 127), Smith (1959) or Smith (1959, pp. 125-208). The final section of the paper, headed 'References', should include only those titles referred to in this way. It should be laid out as follows:

Smith, L. L. (1879). The species of *Danthonia* found in pastures in Victoria. *Austral. J. Bot.* 65: 28-53.

Bentham, G. (1868). "Flora Australiensis", Vol. 4. (L. Reeve: London).

Baker, J.G. (1898). Liliaceae. In Thiselton-Dyer, W. T. (ed.). "Flora of Tropical Africa", Vol. 7. (L. Reeve: Ashford).

Journal abbreviations must be consistent within a paper and authors are recommended to follow "Botanico-Periodicum-Huntianum". Journals not cited in B-P-H should be abbreviated to conform with this general pattern. The following abbreviations for Australian states should be used: WA, NT, SA, Qld, NSW, ACT, Vic., Tas.

Text references to specimens should be italicized, for example *Kock 276.*

Indices

When required, follow the pattern on, for example, p. 106 of vol. 1, pt. 2.

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Benth., *Fl. Austral.* 4: 111 (1868) OR

Benth., *Fl. Austral.* 4: (1868) 111.

Citation of specimens

10-30 specimens should be cited for each species (or subspecific taxon), although this may be varied under certain circumstances. The author may decide whether or not to include dates of collections and the sequence, provided a constant pattern is adhered to throughout a paper.

Authors wishing to cite all specimens seen may list them all in an index to collectors after the style of the "Flora Malesiana" identification lists. Collections not identifiable by a collection number (assigned by either the collector or herbarium) should cite dates.

Correspondence

All correspondence concerning the journal should be addressed to:

The Director, Adelaide Botanic Gardens, North Terrace, ADELAIDE, South Australia 5000.

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MULGA. A REVISION OF THE MAJOR SPECIES

Barbara R. Randell

State Herbarium, Botanic Gardens, North Terrace,
Adelaide, South Australia 5000

Abstract

A review is given of morphology, reproduction, ecology and distribution in taxa of mulga. After an acknowledgement of the need for further study, a new classification of *Acacia* Mill. sect. *Juliflorae* (Benth.)Maiden & Betche is proposed. *Acacia minyura* and *A. paraneura* are described, as well as the two varieties, *A. aneura* F. Muell. ex Benth. var. *macrocarpa*, and *A. aneura* var. *conifera*. A new combination of *A. ayersiana* Maconochie var. *latifolia* (J.Black)Randell is made.

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Introduction

This study was carried out to prepare a treatment for publication in the Flora of Australia. The project comprised the group of species popularly called 'mulga', and belonging to *Acacia* Mill. sect. *Juliflorae* (Benth.)Maiden & Betche (phyllodes many-nerved, spikes cylindrical). The species also share the following group of characters:

Sepals linear-spathulate, almost completely free; seeds relatively large, 4-6 mm long or longer; funicles short, scarcely arillate; pods 5-40 mm wide, chartaceous to coriaceous-crustaceous, conspicuously nerved; tall shrubs or small trees of the arid zone. Each character alone occurs in many other species, it is their combination which is useful in defining the group.

The species listed for the project were *A. aneura*, *A. brachystachya*, *A. craspedocarpa*, *A. ramulosa*, and *A. linophylla*. Other taxa sometimes considered as mulga (*A. ayersiana*, *A. catenulata*, and *A. subtessarogona*) were not included, but early in the study it was found imperative to add *A. ayersiana*, as this is very closely related to forms previously included in *A. aneura*. *A. subtessarogona* and *A. catenulata* were not studied.

Materials and methods

Funding for this project was strictly limited, as was the time allocation of 6 months. There was thus no possibility of organising field work, and the study has been based entirely on observations of specimens in most of the principal herbaria in Australia (AD, BRI, DNA, NSW, PERTH and MEL).

Herbarium studies have been restricted to the recognition of taxa differing in gross morphology, assembling descriptions of these taxa, mapping their distribution, and determining the allocation of the various type specimens selected in the past. Due to the frequent occurrence of individuals of intermediate morphology, many of the taxa have been treated at the intraspecific level. To conform with earlier studies in the group, I have used the variety level. I have then arranged the taxa into groups (species) which I believe reflect their genetic affinities.

The distributions of herbarium specimens in the various taxa were mapped onto a grid of 1° latitude by 1.5° longitude, as has been done for other species of *Acacia* (Maslin and Pedley 1982). Any occurrence of a taxon within a particular cell of the grid was recorded. This grid pattern was then transferred to maps suitable for publication in the Flora of Australia.

The exclusion of field observations from the study must make the results incomplete, in particular due to the reported occurrence of hybrid individuals in many parts of Australia. Also, there have been frequent reports of populations consisting of several different morphological types (e.g. Lamont and Fox 1981, Cody 1989, 1991). However, these reports do not make it clear whether such populations consist of associations of individuals of several taxa, all mutually intersterile; associations of two or more interbreeding taxa and their sterile F1 hybrid offspring (as usually occurs in e.g. *Eucalyptus*); or two or more interbreeding taxa and their fertile F1 and backcross hybrids (as in *Senna*, Randell 1989). In the absence of this information, I have prepared this revision of the group as if all variants occur naturally within taxa, and do not result from hybridization between taxa. Field studies are urgently needed to clarify the nature of these non-uniform populations.

Morphological characters

1. Phyllodes

In this group of species phyllodes show great variation, from terete to falcate to oblong, from 1 to 20 cm long, and from 0.5 to 18 mm broad. However, two groups of taxa can be recognised, those whose phyllodes are usually narrow linear (or rarely terete) and less than 3 mm wide; and those whose phyllodes are falcate to oblong, and from 4 to 18 mm wide. The narrow phyllodes are from 3 to 20 cm long, the broader types from 1 to 12 cm long.

All phyllodes have many longitudinal veins, usually only visible with the use of magnification. (Phyllodes of seedlings and coppice growth of broad phyllode forms may have 3-7 of these veins stronger than the remainder, as noted by Everist 1949). However, in *A. craspedocarpa* the venation pattern becomes clearly reticulate with vein islets little more

than 1 mm in diameter. This is a pattern which recurs in other species outside this group (e.g. *A. verricula* Cowan & Maslin).

Phyllode anatomy of *A. ramulosa* is of the type illustrated by Boughton (1986) as "interrupted", with fibre caps of the veins extending to the sclerified epidermis, thus forming ridges. The terete or narrow linear phyllodes are deeply grooved between the ridges. T-shaped hairs are dense in these grooves, with stomates at the bottom adjacent to the photosynthetic tissue, while the intervening ridges are completely exposed at maturity.

In the remaining taxa, hairs are more regularly distributed, and are appressed to cover the entire surface at maturity. In addition, a layer of clear or opaque resin may develop which covers both the surface and the hairs growing from it.

2. Trichomes

Boughton (1989) described the trichomes on a range of Australian species of *Acacia,* including a specimen referred to *A. aneura* (listings of vouchers were available as an accessory publication to Boughton 1981, but this has not been seen). For this plant, she recorded the presence of two hair types, a T-shaped unicellular non-glandular non-coloured hair, and a club-shaped multicellular glandular coloured hair.

Present study has shown that clear hairs are very widely distributed over stems, phyllodes, peduncles and pods, though often they are later obscured by resin deposits. Those hairs examined in detail are T-shaped, though with shorter arms than indicated by Boughton. In addition, reddish club-shaped glandular hairs are very densely distributed over young organs (of all taxa except *A. ramulosa*), so that the whole growing point appears blackish. As the organs expand, these coloured hairs become more widely dispersed, though they persist on the margins of partly-expanded phyllodes, stems behind the growing point, and particularly on peduncles and young fruits.

The absence of these club-shaped glandular hairs is diagnostic for *A. ramulosa.* Examination reveals that in this species the growing points and young phyllodes of dried specimens are also blackish, but the colour is contained within cells of the epidermis, and all the trichomes are colourless. Peduncles and young fruits in this species also carry only non-glandular hairs. However, coloured deposits are developed within the mesocarp fibres of the fruits of *A. ramulosa.*

The epicarp of fruits of *A. ramulosa* remains densely white-hairy at maturity, while fruits of other taxa often retain a few coloured hairs late in their development, though all the hairs on these fruits may be enveloped within a dense layer of clear or opaque resin.

3. Inflorescences

In all the taxa of this group, flowers are carried in pedunculate spikes. These develop singly (rarely in panicles in *A. paraneura*) in the axils. Peduncles are 0.5-1.5 cm long, spikes are 0.5-3.5 cm long. Peduncles always carry simple hairs, and glandular hairs are present in all taxa except *A. ramulosa.*

4. Flowers

Flowers within the group appear relatively uniform. In general they are 5-merous, the sepals are free or almost free and alternate with the fused petals. There are many stamens, with dorsifixed anthers on long free filaments exceeding the petals. The single superior carpel has several ovules on a single marginal placenta. The outside of the ovary has simple clear hairs, and sometimes additional coloured hairs.

However, it has been suggested (Pedley 1973 and pers. comm.) that there are differences in both the shape of individual sepals and the degree to which these are fused, and that the differences may be of taxonomic importance.

Despite the stringent time limits imposed on the completion of this project, it was possible to examine the flowers of about 40 dried specimens, in the terete-podded (*A. ramulosa*), flat-podded (*A.aneura* var. *aneura*), and oval-podded (*A. cibaria*) taxa. (Voucher specimens are held in AD).

In all the 6 plants of *A. ramulosa* examined, the sepals were c. 1 mm long, and were fused below into a tube c. 0.2 mm long. The lobes of the calyx were spathulate with a fringe of clear hairs.

Fifteen flat-podded plants (*A. aneura* var. *aneura*) were examined. In 3 individuals, the sepals were clearly fused into a tube 0.1-0.3 mm long, in 6 the sepals were free to the base, and in 6 may have been very shortly fused. The lobes varied in shape from linear to spathulate, usually with many clear and some coloured hairs, and with total length varying between 0.5 and 1 mm long.

Twenty individuals with oval-section pods (*A. cibaria*) were examined. In 5, the sepals were clearly fused below into a tube to 0.3 mm long, in 6 they were clearly free to the base, while in the remaining 9 any fusion was too short to be clearly visible. As in the group above, the lobe shape varied from linear to spathulate, with both clear and coloured hairs, and lobe length reached 0.5-1 mm long.

Thus, the suggestion that sepal fusion can be used to distinguish the flat-podded forms from the oval-podded forms has not been supported. Further studies are needed to confirm this decision.

5. Pods

i. *Structural types*

Within the group of taxa, pods are of two structural types. In *A. ramulosa*, they are cylindrical from initiation and are usually elongate (6-12 cm long, though abnormal pods may be much shorter). In the remaining taxa, pods are flat from initiation, (though they may become oval in section due to later development of mesocarp fibres, see below), and are generally much shorter, with only rare plants having some pods exceeding 6 cm long.

All of the pod valves have reticulate venation, in some taxa with the transverse veins more conspicuous, in others with the longitudinal veins better developed. In addition, all of them have a vein which develops at or very near the margin (Everist 1949), and to which the funicle is attached. It is the vein supplying the placenta of the developing seed.

This vein is always absolutely marginal in the cylindrical pods of *A. ramulosa* and the oval-section pods of *A. cibaria.* However, its position varies quite markedly in flat pods. It may be absolutely marginal (sometimes forming a distinct raised rim) through less than 1 mm from the margin (thus marking off an area less than 1 mm wide) to almost 5 mm from the margin (in large fruits of *A. craspedocarpa*).

It is the area between the submarginal vein supplying the funicles, and the margin of the valve, which has been incorrectly termed the "wing". It is sometimes of a slightly different colour to the rest of the valve, especially internally, and this may be due to the different development of fibres in the mesocarp (see below). Despite the inappropriateness of the term, I have chosen to continue its use in the interests of stability.

ii. *Texture*

Pods within the group vary in texture from chartaceous to fibrous crustaceous. This variation results from differences in the development of mesocarp tissue in the pod valve.

The mesocarp of *A. ramulosa*, composed mostly of non-glandular colourless fibres but with a few coloured fibres also present, begins to proliferate very early in the maturation of the valve, so that the pod is cylindrical throughout its development. Mesocarp development is very restricted immediately above the seed, but extensive between seeds. This means that the valve develops around the seed, which eventually occupies a hemispherical depression within the body of the valve. The mature pod is fibrous and coriaceous-crustaceous.

In the valves of oval-section pods of *A. cibaria*, there is extensive formation of mesocarp tissue, but only late in the maturation of the pod. The seed occupies a hemispherical depression in the valve, and the mature pod is fibrous and coriaceous-crustaceous.

In *A. craspedocarpa*, there is limited development of the mesocarp tissue, mainly within the area delimited by the submarginal veins, but the mature valves are crustaceous, and pods remain flat. Pods of *A. paraneura* are also of this type.

In *A. minura*, very little mesocarp tissue is developed, and the mature valves are thin and chartaceous. This type of flat chartaceous pod is also found in *A. aneura* (three varieties), and *A. ayersiana* (both varieties).

6. Seed arrangement

In most taxa, seeds are arranged within the pods almost transversely, but with some tendency towards being oblique. However, in both *A. ramulosa* and *A. cibaria* seeds are arranged longitudinally within the pod. It is only in these last two taxa that there is any extensive development of the mesocarp tissue, but it is not known whether the two situations are genetically or developmentally linked. Further work is needed to clarify this relationship.

7. Seed size

There is considerable variation in seed size within the group. Those taxa apparently closely related to *A. aneura* have the smallest seeds in the group (4-6 mm long), while the marginal *A. ramulosa* and *A. craspedocarpa* have the largest seeds (6-12 mm long). The larger-seeded forms are confined to areas of Western Australia and adjacent states, and presumably they are better adapted for survival in the harsh arid environments where mulga occurs.

The large-seeded forms are those which provide valuable food resources for Aboriginal people, and probably also for native animals.

8. Habit

Plants in this group are shrubs, tall shrubs or small trees. Various authors have discussed habit, sometimes linking it to environmental variables. Everist (1949) gave an extensive coverage of forms in Queensland, while Lamont and Fox (1981) and Cody (1989, 1991) attempted to analyse variation in smaller areas of Western Australia. Fox (1986) presented an overview of variation for the whole of Australia.

Biology

Despite extensive investigation of the biology of many Australian species of *Acacia* (e.g. Knox et al. 1989, Vanstone and Paton 1988 and references therein), information on the species known as mulga is very limited.

1. Sexual reproduction

Acacia ayersiana var. *latifolia* (cultivated, Adelaide Botanic Garden) produces polyad pollen, the number of grains per polyad varying between 8 and 16. Not all the grains are well formed. Both diploid and tetraploid plants have been reported (but without voucher specimens, Pedley 1973), and this may be linked to pollen sterility. Further work is needed to clarify this.

Many arid-zone species of *Acacia* are insect pollinated (Keighery 1982), and this probably applies to mulga as well.

Mulga trees produce hermaphrodite flowers after every heavy fall of rain at any time of year (Preece 1970a), but rain is most frequent in spring and summer. However, not every flowering event is followed by reproduction. Mature pods are not produced unless flowering is initiated by summer rain, and this is followed by rain in the subsequent winter (Davies 1976, Crisp 1978). Thus pods usually mature in summer months. The infrequency of this combination of events is reflected in the collections in Australian herbaria, where almost half of the specimens are unpodded, which renders their identification very difficult. Collectors are urged to make every effort in the future to find even empty pod valves on or in the soil beneath trees, to increase the value of the specimens they collect.

Seeds of all members of the group have similar funicles, once or twice folded, small in size and white to pale yellow to orange in colour. They are thus of the type expected to be transported by ants (O'Dowd and Gill 1986). Seed germination is affected by factors such as temperature, light, and CO_2 (Preece 1970b). Survival of the seedling depends on protection from grazing especially from introduced animals (Burrows 1973) such as rabbits, and sheep. Rabbits in particular may be responsible for the failure of mulga to regenerate (Hall et al. 1964, Lange and Graham 1983, Crisp 1978).

2. Vegetative reproduction

Mulga plants do not produce vegetative shoots from subsurface laterals (Maconochie 1982). As adults, they have low survival after fire (Hodgkinson & Griffen 1982). Trees lopped for fodder do not survive unless several of the basal branches are undamaged (Everist 1949).

3. Ecology

Over the last 50 years, much ecological study has centred around mulga. This is a reflection of the extensive distributional range it occupies and of the importance of the group to the pastoral industry. However, caution should be used in interpreting ecological review papers such as those cited here. The incorrect usage of specific epithets in ecological work may be very misleading, e.g. the name *brachystachya* has never previously been subjected to critical taxonomic study but has been widely used in ecological work. Probably it has not always been used in the same sense. A re-evaluation of ecological concepts may be required following refining of taxonomic concepts in papers such as this.

Mulga associations with mulga as the dominant or co-dominant species occupy 1.5 x 10^6 square kilometres or about 20% of the Australian continent (between 115-151°E and 20-35°E), and are generally described as forming shrublands and open shrublands, or woodlands on more favourable sites (Johnson & Burrows 1981).

The soils on which mulgas occur are red earths, sands, loams and hardpans, apparently of low to moderate waterholding capacity, with little organic matter and low nutrient levels (especially so for phosphorous). Mulgas tend to be absent from very sandy and most clay soils (Walker and Fogarty 1986). As the accompanying distribution maps indicate, they are rarely recorded for the Simpson Desert of Northern Territory and South Australia, the Channel country of western Queensland, the Nullarbor Plain of Western Australia and South Australia, the Great Sandy and Gibson Deserts of Western Australia, and are only scattered within the Victoria Desert of Western and South Australia.

Mulga is predominantly found in areas receiving from 200 to 500 mm mean annual rainfall, but is conspicuously absent from the semi-arid regions with regular summer or winter drought (Nix & Austin 1973).

Mulga exhibits a number of adaptions to aid water uptake and retention and to minimise heat absorption. These include the spatial patterning of populations, where mulga occurring in groves receives run-off rainfall from sparsely-vegetated intergrove areas; growth on plains and sand plains which often receive some run-on water from adjacent hills and low ranges; the capacity to channel rainwater down the phyllodes to the stems so that rainfall is concentrated at the base of the trunk; the hairy, scurfy or resinous covering of the phyllodes; and dormancy during drought, from which the plant revives within 4 days of water becoming available (Johnson & Burrows 1981).

Distribution patterns

Four taxa have very wide distributions.

A. ramulosa is less closely involved in the complex than are most of the other taxa, differing in the absence of glandular hairs, and in pod structure. It occurs across Australia through 114-147°E and 20-34°S. with many collections in western areas of Western Australia and most of South Australia, and fewer collections in eastern Western Australia, Northern Territory, Queensland and New South Wales. This may suggest an origin in the Pilbara region of Western Australia with dispersal in an easterly direction.

A. cibaria shows a pattern similar to that of *A. ramulosa*, though there are many fewer collections in this species. Its distribution extends through 114-148°E and 21-35°S, but generally with more scattered collections than those seen in *A. ramulosa*. Apparently it is never common.

A. aneura var. *aneura* is very widespread, extending through 115-148°E and 18-35°S. It is apparently common in all areas where it occurs.

A. ayersiana var. *latifolia* has a distribution even wider than that of *A. aneura* var. *aneura*, extending through 114-151°E and 21-34°S. It is probably best developed in eastern Australia, where it is the most common taxon encountered, but is less frequently encountered in Western Australia, thus hinting at a possible origin in the east of Australia.

Six taxa have more restricted distributions.

A. ayersiana var. *ayersiana* is restricted to southern Northern Territory (S of 22°S), most

of South Australia and far eastern areas of Western Australia. It probably evolved somewhere in this area. Another broad-phyllode taxon, *A. minyura,* has a similar distribution pattern to *A. ayersiana* var. *ayersiana,* (but extended towards the west coast), and also is likely to have evolved within this distribution area.

A. craspedocarpa is a taxon not central to the problem. It has distinctive reticulate venation of the phyllodes, crustaceous pods and large seeds. It is found only in Western Australia, in areas immediately south of the Pilbara, where it probably originated.

A. paraneura and *A. aneura* var. *conifera* have scattered occurrence across similar areas of Western Australia, Northern Territory and northern South Australia, between 114-136°E and 18-30°S. *A. aneura* var. *macrocarpa* is now very restricted and is found in only a few localities in central Western Australia. The distributions of these three taxa may be remnants of once more-extensive patterns.

In summary, the distribution patterns of most of the taxa in this group suggest evolution of the individual taxa in or near central arid regions of Western Australia, with some taxa never extending their distribution ranges from that area, but others becoming very widespread over inland areas of the continent. It is possible that one taxon may be of eastern origin.

Taxonomic concepts

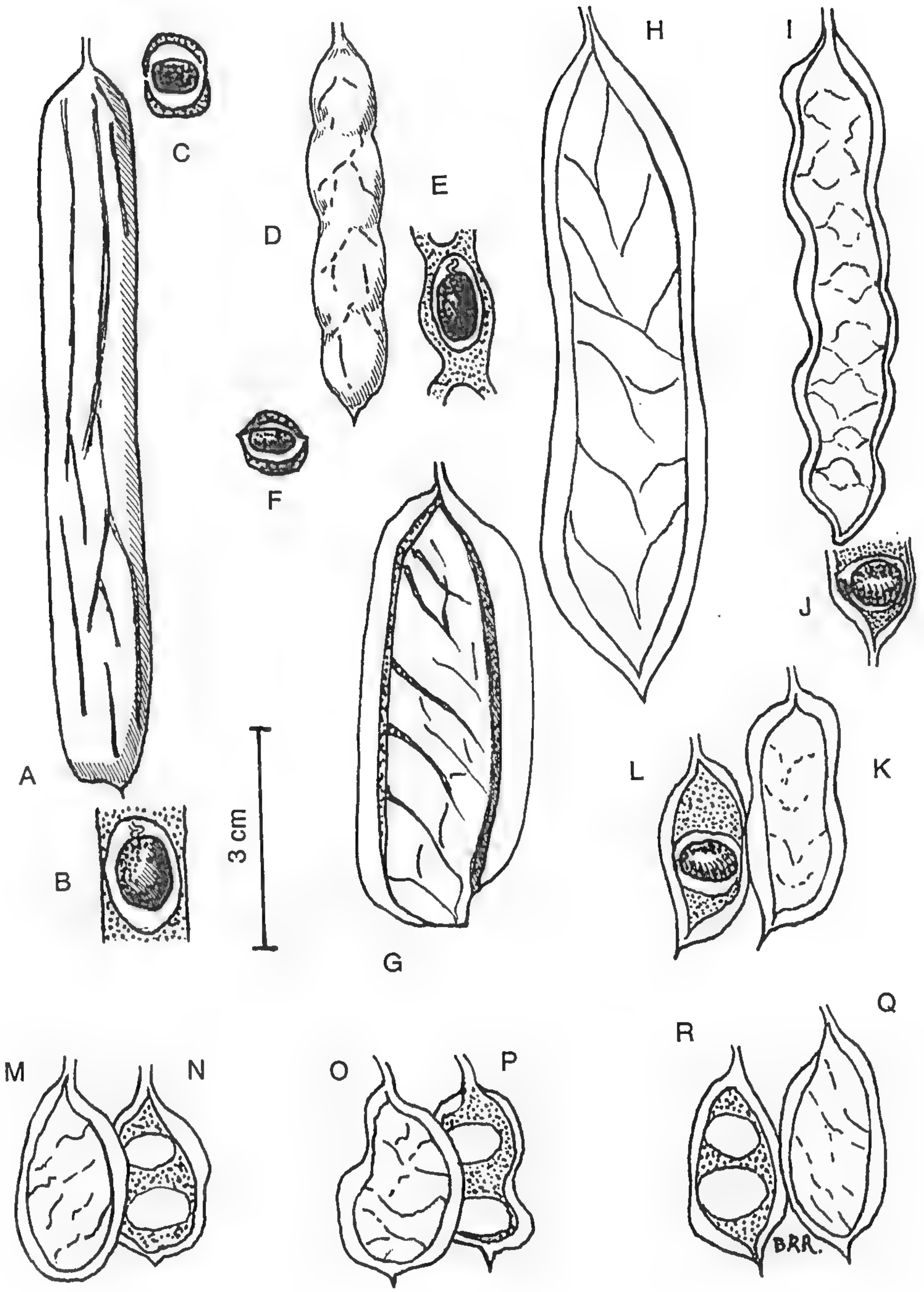
1. Previous attempts at taxon recognition

Several tentative attempts have been made to recognise taxa within the broad range of plants grouped within mulga (e.g. Everist 1949, Pedley 1973, Maslin 1980). These usually looked at characters such as habit, phyllode structure, and pod structure including wing width.

It is my observation that the width of the pod wing is not a good taxonomic character, as it is not a distinct structure in itself, but merely an area not clearly demarcated within an organ (the pod valve). In addition, it may vary at different parts of a single pod, and in different pods on the one plant. On the other hand, pod structure and texture do seem to be reliable.

I have therefore used a combination of phyllode and pod structure to define taxa, but accept considerable variation in pod wing width in many of the taxa recognised here. This taxonomy works reliably on herbarium specimens, but will probably be improved by the addition of field characters in the future.

Fig. 1. Fruits and seeds. A-C, *A. ramulosa* W. Fitzg. (*C.A. Gardner 6016*, PERTH). A, outer surface of valve; B, inner surface of valve showing longitudinal arrangement of seed; C, section through entire pod, showing cylindrical structure of pod. D-F, *A. cibaria* F. Muell. (*R.G. Andrewartha s.n.*, 17.x.1937, AD). D, outer surface of valve; E, inner surface of valve showing longitudinal arrangement of seed; F, section through pod showing flattened structure of pod. G, *A. craspedocarpa* F. Muell. (*H. DeMarz 5672*, PERTH). Outer surface of valve. H, *A. paraneura* Randell (*B.R. Maslin 5627*, PERTH). Outer surface of valve. I-L, *A. aneura* F. Muell. ex Benth. I-J, - var. *aneura* (*L.D. Williams 7450*, AD). I, outer surface of valve; J, inner surface of valve showing transverse arrangement of seed. K-L, - var. *macrocarpa* Randell (*B.R. Maslin 2084*, PERTH). K, outer surface of valve; L, inner surface of valve showing transverse arrangement of seed. M-P, *A. ayersiana* Maconochie, M-N, - var. *ayersiana* (*A.A. Munir 5148*, AD). M, outer surface of valve; N, inner surface of valve showing transverse arrangement of seed. O-P, - var. *latifolia* (J. Black)Randell (*Morris 7596*, AD). O, outer surface of valve; P, inner surface of valve showing transverse arrangement of seed. Q-R, *A. minyura* Randell (S. Midgley 525, PERTH). Q, outer surface of valve; R, inner surface of valve showing transverse arrangement of seed.


A
B
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3 cm
BRR.

2. Discussion of 'habit taxa'

Specific epithets can be determined only by the linking of taxon descriptions, type specimens, protologues, and epithets. This paper links all four elements to produce a formal taxonomic treatment.

In the past, the lack of a detailed understanding of the morphological variation and taxonomy of the group has made it difficult to identify many of the variants met with in the field. In the absence of pods, some workers have been forced to determine taxa by differences in habit. However, such taxa cannot necessarily be linked with the taxa recognised here.

While these workers are recognising real variation in the field, it is now known that shrub or tree habit in mulga may be directly influenced by the environment in which it is occurring e.g. "a tree 10-15 m tall in the mesic areas, but only exists as a stunted low shrub 2-3 m tall in very xeric habitats or where it occurs on very shallow or calcarous soils" (Johnson and Burrows 1981). Also, shrubby and poorly productive ("hard") mulga can be induced to continue growth to form trees with heavier foliage crops ("soft mulga") by management practices such as scarifying the soil to improve water uptake (Batianoff, pers. comm.).

In addition, with the exception of *A. paraneura* and *A. aneura* var. *conifera*, herbarium records have not permitted me to link habit variation with individual taxa.

If it is necessary to recognise "habit forms" for whatever reason (e.g. if no pods are available to separate the narrow-linear phyllode taxa *A. aneura* vars. *aneura* and *macrocarpa*, and *A. cibaria*), I suggest that descriptive phrases be used, not the epithets of formal taxonomy.

However, I am sure that field study will bring to light other characters, probably including variation in habit, which can be used for field identifications of the formal taxa. Time constraints have prevented me from finding these characters. I hope that other workers will report them in the future.

Revision

As a result of the examination of several thousand herbarium specimens, the following arrangement of taxa is proposed. Further study, including extensive field work and the elucidation of the biology of the group, especially with respect to hybridization, is clearly needed. This may lead to considerable modification of this taxonomy.

Key to the species of mulga

1. Plants without reddish glandular hairs even on growing points; phyllodes deeply grooved, with non-glandular branched hairs densest in the grooves, the intervening ridges glabrescent and not covered by tips of hairs spreading from the grooves, without resin; mature pods cylindrical and densely white-hairy .... 1. *A. ramulosa*

1. Plants with reddish glandular hairs especially dense on growing points, but still obvious on expanded organs especially peduncles and young stems; phyllodes not deeply grooved, non-glandular branched hairs persistent over surface, sometimes later enveloped in layers of opaque resin; mature pods usually flat, if not then moniliform, 4-angled, or oval in section, not densely white-hairy:

   2. Phyllodes terete to narrow linear, mostly 0.5-3 mm wide, sometimes a few on each plant wider reaching 5 mm:

3. Branches and phyllodes drooping; pods crustaceous and flat, with mainly longitudinal veins .... 2. *A. paraneura*
3. Branches more or less erect or spreading or horizontal, phyllodes neither rigidly erect nor drooping; pods chartaceous and flat with transverse veins, or rarely fibrous and coriaceous-crustaceous, oval in section and with longitudinal veins:

    4. Mature pods chartaceous, flat, usually sparsely hairy between mainly transverse veins, though sometimes hairs enveloped in layers of opaque resin .... 4. *A. aneura*
    4. Mature pods fibrous and coriaceous-crustaceous, oval in section, glabrescent between mainly longitudinal veins, not usually resinous .... 3. *A. cibaria*

2. Phyllodes narrow linear, elliptic or falcate, mostly 5-20 mm wide, sometimes a few on each plant narrower (4 mm):

    5. Phyllodes of each plant mostly 5-12 cm long, rarely a few shorter:

        6. Phyllodes with dense reticulate veins; pods with crustaceous valves and raised reticulate veins .... 7. *A. craspedocarpa*
        6. Phyllodes without reticulate veins; pods with chartaceous valves, and reticulate veins not raised:

            7. Shrubs or small trees to 3 m tall; phyllodes 1-2.5 cm long; plants with very dense opaque resin cover soon developing on phyllodes, stems, peduncles, and unexpanded spikes, but not covering persistent reddish stipules or mucros .... 6. *A. minyura*
            7. Tall shrubs or trees 3-10 m tall; phyllodes 1.5-7 cm long; plants with resin cover thin or in flakes; stipules not conspicuous .... 5b. *A. ayersiana* var. *latifolia*

    5. Phyllodes of each plant mostly 1-5 cm long, rarely a few longer:

        8. Pods flat .... 5a. *A. ayersiana* var. *ayersiana*
        8. Pods 4-angled or moniliform .... *A. subtessarogona*, *A. catenulata*

1. **A. ramulosa** W. Fitzg., *J. West Australian Nat. Hist. Soc.* 2(1):15 (1904).

Lectotype: Lennonville, ix.1903, *W.V. Fitzgerald s.n.* (PERTH, lecto. here chosen —a leafy twig with attached pod, and seed in a packet); isolecto.: (NSW! — a leafy twig with detached pods and no seeds, photo AD, PERTH).

As it is very probable that all the syntypes were available to the author, lectotypification seems necessary. The type collection is unlikely to have been broken up in the short period between the date of collection and the date of publication.

Synonyms

1. *A. linophylla* W. Fitzg., *J. West Australian Nat. Hist. Soc.* 2(1):16 (1904).

Lectotype: Nannine, Cue, Mt Magnet, ix. 1903, *W.V. Fitzgerald s.n.* (PERTH, lecto. here chosen — a leafy twig with detached pod, an open valve and seeds in packet); syntype: (PERTH! —a leafy twig with closed pods and no seeds).

Lectotypification seems desirable as three localities (Cue, Nannine and Mt. Magnet) are given in the protologue.

2. *A. cibaria* F.Muell., *Australas. Chem. & Druggist, Suppl.* 5(51):26 (1882) p.p., as for several syntypes i.e. *"near the Murchison R., Ch. Gray s.n."* (MEL!); *"near the Gascoyne R., Oliver Jones s.n."* (MEL!); "fruits and seeds from Shark Bay, labelled Wonuy, *sin. coll., s.d."* (MEL!).

3. *Racosperma ramulosum* (W. Fitzg.)Pedley, *Austrobaileya* 2:354 (1987).
Lectotype: as for *A. ramulosa* W. Fitzg.

Description

Shrub or small tree to 4 m, phyllodes erect; bark rough below, smooth and reddish above; growing points densely simple hairy over reddish epidermis, glandular hairs almost entirely absent. *Phyllodes* terete or narrow linear, 6-16 cm long, 1-3 mm wide, deeply grooved, with dense T-shaped hairs mostly confined to grooves, finally glabrous and naked on the ridges, rarely with surface resin deposits, usually olive green. *Inflorescence* oblong 7-23 mm long; peduncles 3-6 mm long, with only simple hairs. *Pod* pendulous, terete even when young, becoming thicker and coriaceous-crustaceous with early development of fibrous material in valve mesocarp except above seed, 20-180 mm long, 3-11 mm wide; when mature densely clear or white hairy between conspicuous dark longitudinal veins; seeds longitudinally arranged. *Seeds* 5-8 mm long, 3-6 mm wide, oval, dark glossy brown, areole area sunken; funicle subterminal, yellow. Bowgada (in Western Australia) or horse mulga (eastern States).

Illustrations: Fig. 1A-C; R. Erickson et al. (1982, p.146) as *A. linophylla*; G.M. Cunningham et al. (1981, p. 350); Whibley (1980, p. 209).

Distribution and ecology

Found in all mainland states except Victoria, but more common in the western parts of the continent; usually growing in sand on or between ridges or in clay, rarely in laterite. Map 1.

Notes

All individuals in this taxon are linked by the absence of glandular epidermal hairs, and the presence of terete crustaceous pods. There is variation in phyllode structure from narrow-linear (*A. ramulosa* W. Fitzg.) to terete (*A. linophylla* W. Fitzg.). However, I have not been able to recognise differences in the distribution patterns or ecological requirements of the two forms. For this reason, I consider the two names synonyms. As the narrow-linear forms are more common, I have retained the name *A. ramulosa* for the taxon. For further discussion of this problem, see Maslin (1980).

The funicle is attached at the peduncle end of the pod. The plants apparently crop more regularly, produce more pods per crop, and have more and larger seeds per pod than do other taxa in this group. The seeds are an important food source for Aborigines; names recorded are wonuy (W.A.), palpa (N.T.) and wintalyka (S.A.).

Selected specimens (several hundred seen)

WESTERN AUSTRALIA: 16 miles [c. 40 km] NE Morawa, towards Yalgoo, *B.H. Smith 498*, 26.x.1984 (BRI, CANB, MEL, NSW, PERTH)

NORTHERN TERRITORY: Curtin Springs station, *P.K. Latz 5687*, 18.ix.1974 (BRI, DNA, PERTH).

SOUTH AUSTRALIA: c. 19 km W Termination Well, which is c. 40 km NW Leigh Ck, *T.R.N. Lothian 3475*, 14.xi.1964 (AD, CAL, CANB, SI).

QUEENSLAND: 49 km SE Adavale towards Charleville, *J.R. Maconochie 2771*, 5.vii.1981 (CANB, DNA, MEL, NSW, PERTH).
NEW SOUTH WALES: Mootwingee Ras, c. 110 km NE Broken Hill, *M. Fagg 4*, 13.v.1964 (AD).

2. **A. paraneura** Randell, sp. nov.

A. aneurae affinis sed ramulis et phyllodiis longioribus pendulisque, leguminibus longioribus rigidisque differt.

Holotype: 18 km from Wongawol homestead (which is c. 223 km. E Wiluna) towards Carnegie on the Gunbarrel hwy, *B.R. Maslin 5627*, 6.ix.1984 (PERTH); iso.: (BRI!, CBG, MEL!).

Description

Shrub or small tree to 10 m tall; branches and phyllodes pendulous; bark grey, upper branches red and shining; stems silvery hairy, often very resinous; growing points hairy with simple and glandular hairs, these latter very dense on young parts but becoming dispersed as organs expand. *Phyllodes* terete, very long, 5-20 cm long, 0.8-1 mm wide, silvery hairy. *Inflorescence* oblong, 10-20 mm long; peduncle 5-8 mm long, with simple and glandular hairs. *Pod* flat, 15-90 mm long, 8-15 mm wide, rigid, crustaceous, silvery hairy between the (longitudinal) reticulate veins, resinous when mature, rich brown; wing 1.3-3 mm wide, obvious all round; seed arrangement transverse to oblique. *Seed* rather small, 4-6 mm long, 2-4 mm wide, oval, glossy, dark brown; areole flat; funicle with several folds, relatively large. Weeping mulga.

Illustrations: Fig. 1H; Midgley & Gunn (1985, fig 2d); Fox (1986, p. 31).

Distribution and ecology

Dispersed over extensive areas of arid Western Australia and Northern Territory, usually growing on sandy flats or among rocks. Map 2.

Notes

A very distinctive taxon, easily recognised by its long flexible phyllodes and its unique pods. The latter are obviously winged, flat and crustaceous (not chartaceous as are those of e.g. *A. aneura*), with reticulate veins predominantly longitudinal or V-shaped (see Fig. 1h).

Usually described as a graceful tree, perhaps with horticultural potential. The occurrence of non-weeping individuals with similar pods suggests that this taxon may intergrade with *A. aneura* var. *aneura*. The name reflects the affinity with that species.

Selected specimens (about 50 seen)

WESTERN AUSTRALIA: Lake Cohen, 80 km N Gunbarrel hwy, *S.J. Midgley 659*, 10.xi.1983 (CANB, PERTH); 41.5 km from Wongawol homestead on Gunbarrel hwy to Carnegie homestead, *B.R. Maslin 5629*, 6.ix.1984 (CBG, PERTH).

NORTHERN TERRITORY: 10 miles [c. 16 km] E Coniston homestead, *G. Chippendale s.n.*, 11.viii.1959 (AD, DNA, NSW); c. 2 miles [c. 3 km] W Kurringa Bore, Mt Wedge, *A.O. Nicholls 885*, 2.vi.1968 (BRI, DNA, MEL, NSW).

3. **A. cibaria** F.Muell., *Australas. Chem. & Druggist* 5(51):26 (1882).

Type citation: "between the Darling R. and Barcoo, Dr Beckler ", not located.
Lectotype: Yuyinga Mts, Victorian Expedition, [Scrope Ra., c. 43 miles [c. 65 km] E Broken Hill, N.S.W., see Willis 1960], 6.xi.1860, *Dr Beckler s.n.* (MEL! lecto. here chosen — with pods, photos AD & PERTH); isolecto.: (NSW! — with pods); syntypes: [Scrope Ra., N.S.W.], 7.xi.1860, *Beckler 2* (MEL! —without pods, photos AD & PERTH); [Scrope Ra.], 6.ix.1860, *Victorian Expedition s.n.* (MEL! —without pods, photos AD & PERTH); fragment of MEL, but not clear which sheet (PERTH! — without pods); [Scrope Ra.], -.xi.1860, *Victorian Expedition s.n.* (K, n.v., fide Pedley 1978).

Lectotypification

In the protologue Mueller refers to at least 3 collections. These elements are not conspecific, as Mueller later recognised (cited in Tate 1882), and as noted by both Pedley

(1978) and Maslin (1980).

I agree with both Maslin and Pedley that one of these collections ("Murchison R., *C. Gray s.n.*", MEL!) is the same as that described by Fitzgerald in 1904 as *A. ramulosa,* and with Maslin that a second ("Gascoyne R., *O. Jones s.n.*", MEL! — pods and seeds only) could also be *A. ramulosa.*

If the name cibaria is lectotypified on either of these collections, then *A. ramulosa* will be reduced to synonomy. As *A. ramulosa* is very widespread, very common, and has not been confused in the past, this would be very undesirable.

The other collection cited in the protologue ("between the Darling R. and Barcoo, *Dr Beckler s.n.*") was that believed by Mueller (in Tate 1882) to represent *A. aneura* var. *stenocarpa* Benth. The locality for this was given by Bentham as "Barrier Ra., Victorian Expedition". The only material collected on this expedition and matching his description ("pods turgid, seeds longitudinal") was gathered by Dr Beckler between November 5 and 7, 1860. One of the listed syntype sheets ("7.xi.1860, *Beckler 2*", MEL!) has the locality citation "near the Barrier Ra.". At this date, Beckler recorded his position as Goginga Mountains, which was variously interpreted "Goginya, Goyinga, Gozinga, Guginga, Yayinga, Yayinya, Yuyinga, Yuyingee, Toguya etc of Mueller and Bentham" (Willis, 1960).

For this reason, sheets bearing any of the above locality citations (equated with Scrope Ra., N.S.W. by Willis in 1960), or collected between November 5th and 7th 1860, and with either Dr Beckler or Victorian Expedition as collector, may be considered syntypes.

Maiden (1917) explicitly equated this material with the name *A. brachystachya* Benth. (for a discussion on the application of this name, see below). Pedley (1978) chose this material as the lectotype of the name *A. cibaria*, because "Maiden implied that nomenclatural problems would be solved by selecting [it]".

However, in specifying that the lectotype for the name *A. cibaria* should be "Yayinya Mountains, Nov. 1860, *Beckler s.n.;* MEL" Pedley was also citing mixed material. There are 3 sheets in MEL fitting this description, and also others in NSW and K (as *A. aneura* var. *stenocarpa* Benth.), but Pedley did not specify or annotate a particular sheet or specimen. As the sheets are not identical, but have differing label details (e.g. for date in November, and Beckler's collection number), and not all have pods, his designation is not adequate to resolve the problem. This being so, I have taken the opportunity to refine his lectotypication on the only MEL sheet bearing pods, as these are essential in establishing the identity of *A. cibaria.*

Synonyms

1. *A. aneura* var. *stenocarpa* Benth., *Fl. Austral.* 2:403 (1864).
Type citation: "Barrier Ra., *Victorian Expedition s.n.*"; not located.
Lectotype here chosen: as for *A. cibaria* in the sense adopted here (including the selected lectotype but excluding material treated under *A. ramulosa*). Full details of the reason for selecting the lectotype are discussed under *A. cibaria.*

[Pedley (1978) cites as holotype the collection in K, but all the MEL sheets are initialled as having been seen by Bentham, thus establishing them as syntypes. The NSW sheet may not have been seen by Bentham.]

2. *A. brachystachya* auct. non Benth.: Maiden (1917b), Pedley (1973). In this treatment, *A. brachystachya* Benth. has been excluded from consideration, for reasons discussed below.

Description

Bushy shrub or small tree to 6 m tall, phyllodes ascending; bark dark grey, finely fissured; growing points young stems and peduncles densely hairy with simple and glandular hairs, the latter very dense on young parts but becoming dispersed as organs expand. *Phyllodes* narrow-linear, rarely terete, ascending, not deeply grooved, 6-10(-15) cm long, 0.5-3 mm wide, grey-green, hairy with pale hairs densest over veins but spreading over whole surface; opaque resin often covering old phyllodes. *Inflorescence* oblong, 10-20 mm long; peduncle 4-12 mm long, with both simple and glandular hairs. *Pod* 15-75 mm long, 4-8 mm wide, quite flat when young, becoming turgid and crustaceous late in development [with the development of thick fibrous mesocarp within valves], not winged, densely hairy between veins when young but often glabrescent; reticulate veins clear, often slightly resinous, more obviously longitudinal than transverse; seed arrangement longitudinal. *Seeds* 5-8 mm long, 3-5 mm wide, oval, glossy golden brown, areole area sunken and paler; funicle subterminal and orange. Turpentine mulga.

Illustrations: Fig. 1D-F; Maiden (1917b, p.15); Whibley (1980, p.216).

Distribution and ecology

Found in all mainland states except Victoria, usually growing in red sand on dunes or swales, rarely in rocky streams. Map 3.

Notes

Though it is of wide distribution, it does not appear to be common in any locality. Frequently confused in the past with both *A. ramulosa* and *A. aneura* var. *aneura*. *A. ramulosa* does not have glandular epidermal hairs, and its mature pods are terete, not oval-sectioned as in *A. cibaria*. *A. aneura* has flat chartaceous pods, not coriaceous-crustaceous as in *A. cibaria*.

Reported as being unpalatable to stock.

Selected specimens (about 80 seen)

WESTERN AUSTRALIA: Glenorn station, *N.T. Burbidge 286 & 288*, viii.1938 (PERTH); Southern Murchison, *D.L. Anderson s.n.*, 26.x.1939 (AD); Giles, Rawlinson Ra., *J.B. Cleland s.n.*, 27.vi.1958 (AD); 8 km N Mt Magnet on Great Northern Hway towards Meekatharra, *B.R. Maslin 4509*, 20.viii.1985 (PERTH); 3.5 km NNE Randall Well, Yarlarweelor station, *R.J. Cranfield 5584*, 10.viii.1986 (PERTH).

NORTHERN TERRITORY: 37 miles [c. 56 km] NE Lake Mackay, *G. Chippendale s.n.*, 16.vi.1957 (DNA); Reedy Rock Hole, George Gill Ra., *A.C. Beauglehole 20478*, 10.x.1966 (MEL); 6 miles [c. 9 km] S Alice Springs, *D.J. Nelson 2265*, 30.iii.1973 (DNA); 25 km NW Ayres Rock, *P.K. Latz 5734*, 21.ix.1974 (DNA); S Haasts Bluff, *P.K. Latz s.n.*, 8.xi.1976 (DNA).

SOUTH AUSTRALIA: Roopena homestead, c. 20 km NW Whyalla, *E.H. Ising s.n.*, 5.xi.1936 (AD); Termination Well, c. 60 km NW Leigh Creek, *T.R.N. Lothian 3475*, 14.xi.1964 (AD); c. 1 km NW Mt Gunson Copper Mine, *H. Eichler 18883*, 24.x.1966 (AD); 6 km SW Waukatanna waterhole, Coopers Ck., *F. Badman 349*, 6.xi.1981 (AD, BRI, MEL, NSW).

QUEENSLAND: Quilpie Common, *S.L. Everist 5905*, 10.xi.1957 (BRI; MEL); 3 miles [c. 5 km] W Windorah, *S.L. Everist 7385*, 1.viii.1963 (BRI, MEL); Quilpie, *L. Pedley 2453*, 11.ix.1967 (DNA).

NEW SOUTH WALES: Mundi Mundi, near Broken Hill, *E.F. Constable s.n.*, 23.xi.1947 (DNA); c. 25 miles [c. 40 km] SE Louth, *C.W.E. Moore 4196*, 25.ix.1966 (MEL); 19.2 miles [c. 32 km] from Engonnia towards Bourke, *M. Hall H78/84*, 19.ix.1978 (MEL); 4.5 km S Olive Downs homestead, NNW Tibbooburra, *R.G. Coveny 13449*, 2.ix.1989 (AD, BRI, NSW).

4. **A. aneura** F.Muell. ex Benth., *Linnaea* 26:627 (1855)

Lectotype: Cudnaka, [S.A.], *F. Mueller s.n.* (MEL! lecto. here chosen, — larger specimen with almost mature pods showing transverse seed arrangement, but without flowers); syntypes: Cudnaka, *F. Mueller s.n.* (MEL! —fragmentary, with 2 attached pods, photo AD, BRI, PERTH); fragment of MEL (PERTH!); 2 fragments from Sonder herbarium (MEL!).

Both MEL sheets were seen by Bentham, so lectotypification appeared necessary.

Synonym

Racosperma aneurum (F.Muell. ex Benth.)Pedley, *Austrobaileya* 2:344 (1987).
Lectotype: as above.

Description

Shrub or small tree to 5 m tall, branches ± erect, spreading or horizontal; hairs dense on growing points mostly simple T-shaped but many reddish glandular, these last dense on growing points but becoming less dense as organs expand. *Phyllodes* terete to narrow linear, 2-11 cm long, 0.5-3 mm wide. *Inflorescences* oblong, 8-25 mm long; peduncles with both simple and glandular hairs, 3-9 mm long. *Pod* 10-100 mm long, 4-20 mm wide, chartaceous, veins reticulate usually mostly transverse; seed arrangement transverse slightly oblique. *Seeds* variable 4-9 mm long, 3-8 mm wide, glossy dark brown.

Distribution and ecology

The type variety is very widespread through all mainland states except Victoria, var. *conifera* is scattered through Western Australia, Northern Territory and South Australia, but var. *macrocarpa* occurs only in Western Australia.

Notes

All individuals in this species are linked by the possession of glandular epidermal hairs, and flat chartaceous pods with (usually) inconspicuous wings. By contrast, *A. ayersiana* and *A. minyura* both have wider phyllodes, and *A. cibaria* has coriaceous-crustaceous pods which are oval in section when mature.

Key to the varieties of *A. aneura*

1. Branches ± erect, or spreading:
   2. Pods 10-50 mm long, often winged, golden brown .... 4a. var. *aneura*
   2. Pods 20-100 mm long, not winged, often yellowish .... 4b. var. *macrocarpa*
1. Branches horizontal .... 4c. var. *conifera*

4a. **A. aneura** var. **aneura**.

Description

Bark dark grey. *Phyllodes* 3-11 cm long, 0.7-3 mm wide (a few on each plant to 5 mm), terete to narrow linear (rarely almost elliptic), falcate, grey-green; old phyllodes not deeply grooved, hairs densest in shallow grooves but spreading to cover whole surface, finally more or less opaque resinous. *Pod* 10-50 mm long, 4-15 mm wide, chartaceous, often resinous, densely hairy between reticulate (predominantly transverse) veins, always flat, without fibrous buildup within valves, grey-green becoming gold brown at maturity;

wing 0-1 mm wide, variably obvious. *Seeds* relatively small, 4-6 mm long, 3-4 mm wide, oval, glossy deep brown; areole area flat, paler; funicle terminal, creamy. Typical mulga, narrow leaf mulga.

Illustrations: Fig. 1I,J; Whibley (1980, p. 214).

Distribution and ecology

Very widespread through all mainland states except Victoria; grows in red sandy loam or gravel. Map 4.

Notes

Typical mulga is recognised by the presence of glandular epidermal hairs, flat and chartaceous pods, and narrow phyllodes, most of which are less than 3 mm wide. In contrast, *A. ramulosa* lacks glandular hairs, *A. cibaria* has pods oval in section, both *A.ayersiana* and *A. minyura* have broader phyllodes, and *A. paraneura* has flat crustaceous pods.

Palatable to and heavily grazed by imported animals including rabbits, goats, sheep and cattle. An important fodder plant to the pastoral industry.

Intergrades with (perhaps because of hybridization) *A. ayersiana* vars. *ayersiana* and *latifolia.*

Selected specimens (several hundred seen)

WESTERN AUSTRALIA: c. 40.2 km S Windy Corner, *A.M. Ashby 5422*, viii.1976 (AD, PERTH).

NORTHERN TERRITORY: c. 15 km N Andado homestead, Simpson Desert, *J.Z. Weber 966*, 11.vii.1968 (AD, DNA, HO, PERTH).

SOUTH AUSTRALIA: c. 6 km E Tallaringa Well, 140 km W Coober Pedy, *T.R.N. Lothian 2719*, 4.v.1964 (AD, MEL).

QUEENSLAND: near Buckingham Downs, c. 50 km S Dajarra, *L. Pedley 5296*, 9.x.1984 (BRI, MEL).

NEW SOUTH WALES: 11 miles [c. 18 km] N Broken Hill, *E.H. Ising s.n.,* 15.x.1921 (AD).

4b. **A. aneura** var. **macrocarpa** Randell, var. nov.

A. aneurae var. aneurae affinis sed leguminibus et seminibus grandioribus, leguminibus maturis luteolis differt.

Holotype: upper Rudall R. area, W.A., *B.R. Maslin 2084,* 3.ix.1971 (PERTH — leafy specimens with attached pods).

Description

Bark grey finely fissured, smooth on branches. *Phyllodes* 4-10 cm long, 1-2 mm wide, terete or narrow linear; phyllodes and stems silvery hairy, later resinous. *Pod* 20-100 mm long, 7-20 mm wide, not usually winged, often with distinct rim or narrow edge, flat, chartaceous to coriaceous, sparsely hairy between mainly longitudinal reticulate veins, pruinose, sometimes raised over seeds, pale brown when immature, often almost yellow at maturity; seed arrangement almost transverse. *Seeds* 6-9 mm long, 4-8 mm wide, oval, dark

glossy brown, areole area flat, funicle terminal, long and folded. Yellow pod mulga; large-pod mulga.

Illustrations: Fig. 1K, L.

Distribution and ecology

Occurs only in a few areas in central Western Australia, where it has been reported growing in red sand or loam, or rarely along stony watercourses. Map 5.

Notes

The only apparent differences between this and var. *aneura* are the much larger seeds and the longer fruit of var. *macrocarpa*. Not identifiable without fruit. The name describes the conspicuously larger fruit.

There is also a group of specimens with larger crustaceous fruit whose veining pattern suggests derivation from *A. paraneura* e.g. *Maslin 2183* (BRI, K, MEL, PERTH).

Specimens (all those seen)

WESTERN AUSTRALIA: Mt Russel, W of Wiluna, *N.T. Burbidge 4794*, 11.xii.1955 (CANB, PERTH); Towera station, *J.S. Beard 3619*, 25.vii.1964 (PERTH); Ashburton Downs, *J.S. Beard 6117*, -.viii.1970 (PERTH); Rudall R., *M. McInnes 13*, 5.x.1971 (PERTH); upper Rudall R. area, *B.R. Maslin 2182*, 8.ix.1971 (BRI, DNA, PERTH); upper Rudall R. area, *B.R. Maslin 2216*, 9.ix.1971 (AD); upper Rudall R. area, *B.R. Maslin 2292*, 14.ix.1971 (DNA, PERTH); c. 11 km NW Newman towards Rhodes Ridge, *B.R. Maslin 4589*, 8.vii.1980 (PERTH); S end of Varoo station, *J. Stretch s.n.*, viii.1981 (PERTH); 8 km S Wiluna on road to Agnew, *B.R. Maslin 5396*, 19.ix.1983 (PERTH).

4c. **A. aneura** var. **conifera** Randell, var. nov.

A. aneurae var. aneurae affinis sed ramis horizontalibus, habitibus arborum coni fer arum et plerumque phyllodiis brevioribus differt.

Holotype: c. 25 km NNW Yuendumu, N.T., 25.viii.1981, *P.K. Latz 8804* (PERTH); iso.: (DNA!, CBG n.v.).

Description

Branches horizontal, young growth very viscid; bark dark grey, rough or flakey. *Phyllodes* terete or narrow linear, rigid, 1.5-10 cm long, 0.5-2 mm wide; phyllodes and stems silvery hairy, soon resinous. *Pods* 15-25 mm long, 6-8 mm wide, chartaceous, rimmed but not winged, with sparse hairs, without resin; seed arrangement transverse; golden brown. *Seeds* small, 4-6 mm long, 3-4 mm wide, glossy brown, oval; areole flat, funicle almost terminal, pale. Christmas tree mulga, conifer mulga.

Illustrations: Boomsma and Lewis (*Bulletin 25*, p. 46).

Distribution and ecology

Collected from Western Australia and Northern Territory, of very scattered distribution. Usually grows in sandy loam or on rocky ridges. Map 6.

Notes

Herbarium specimens have only been assigned to this taxon when the label has contained reference to the coniferous habit. Most of the specimens have short terete phyllodes, more rigid than those of other varieties of *A. aneura*. The pods are flat and chartaceous, without wings, indicating a close relationship to *A. aneura.*

A conspicuous habit variant, perhaps worth recognising taxonomically. The name derives from the coniferous growth habit.

N.B. no authenticated material collected in S.A. has been seen, but the photograph listed above was taken in the far north west of South Australia.

Selected specimens (about 80 seen)

WESTERN AUSTRALIA: 4 miles [c. 6.5 km] E Notabilis Hill, Gunbarrel hwy, Gibson Desert, *A.S. George 5376,* 25.vii.1963 (PERTH); 30 km ENE Gindalbie homestead, c. 57 km NNE Kalgoorlie, *P.G. Wilson 7524,* 31.viii.1968 (PERTH); upper Rudall R. area, *B.R. Maslin 2220,* 9.ix.1971 (DNA); Canning Stock Route, N Lake Disappointment, *B.R. Maslin 2273a,* 12.ix.1971 (MEL); 9 km W Laverton, c. 110 km NE Leonora, *S.J. Forbes s.n.,* 9.x.1983 (PERTH).

NORTHERN TERRITORY: 15 miles [c. 24 km] SE Anningie homestead, *G. Chippendale s.n.,* 29.vii.1958 (MEL, NSW); 7 miles [c. 11 km] W Alice Springs towards Hermannsburg, *D.J. Nelson 1603,* 15.xi.1967 (DNA); 5 km W Gahnda Rockhole, Gibson Desert, *A. Kalotas 1128,* 1.iv.1982 (DNA); Leaders Mine, Kurundi station, *P.K. Latz 9796,* 28.ix.1983 (DNA).

5. **A. ayersiana** Maconochie, *J. Adelaide Bot. Gard.* 1(3): 182 (1978).

Holotype: Ayres Rock, N.T., 19.x.1973, *J.R. Maconochie 1930* (NT, n.v., fide Maconochie, *J. Adelaide Bot. Gard.* 1(3): 182 (1978)); iso.: (AD!, BRI!, DNA!, NSW!, PERTH!).

Description

Shrub or tree 2-10 m tall; bark dark grey, fissured; vegetative parts with simple and glandular hairs, these latter dense on growing points, becoming dispersed as organs expand. *Phyllodes* falcate to elliptic, 2-12 cm long, 4-12 mm wide, densely simple hairy, resinous. *Inflorescences* oblong, 8-30 mm long; peduncles simple and glandular hairy, 3-15 mm long. *Pod* 10-60 mm long, 5-25 mm wide, flat, chartaceous, transverse reticulate veined, sometimes resinous; seed arrangement transverse to oblique. *Seed* 3-8 mm long, 2-7 mm wide.

Notes

Individuals are linked by the possession of glandular epidermal hairs, flat chartaceous pods (often with conspicuous wings) and elliptic to falcate phyllodes, mostly more than 5 mm wide. In *A. aneura*, the phyllodes are narrower, and in *A. minura,* the phyllodes are much shorter.

Key to the varieties of *A. ayersiana*

1. Phyllodes 4-12 cm long, 4-12 mm wide; pod wing 1-2 mm wide............5a. var. *ayersiana*
1. Phyllodes 1.5-7 cm long, 4-10 mm wide; pod wing 0-1 mm wide............5b. var. *latifolia*

5a. **A. ayersiana** var. **ayersiana**

Description

Phyllodes 4-12 cm long, 4-12(-18) mm wide, usually falcate rarely elliptic, densely hairy, grey green; opaque resin developing on phyllodes and stems. *Pod* 12-40 mm long, 8-17 mm wide, flat, chartaceous, sparsely hairy, not resinous, brown; wing 1-2 mm wide, conspicuous; seed arrangement transverse. *Seed* to 6 mm long, to 3 mm wide, oval, glossy, dark brown; funicle subterminal small yellow. Blue Mulga.

Illustrations: Fig. 1M, N; Maconochie, *J. Adelaide Bot. Gard.* 3: 181, Fig. 2 (1978).

Distribution and ecology

Occurs in eastern Western Australia, south of Northern Territory and western South Australia, usually in red sand or earth, with clay, sometimes in swales. Map 7.

Notes

This taxon is characterised by short pods with conspicuous wings, and long phyllodes. The common name derives from the bluish tinge given to the phyllodes by the resinous deposit covering them.

Selected specimens (about 50 seen)

WESTERN AUSTRALIA: Coolgubbin, c. 16 km S Neales Junction, *B.C. Crisp 27*, 20.v.1974 (AD); Coolgubbin, c. 16 km S Neales Junction, *B.C. Crisp 46*, 21.v.1974 (AD); 110 km by road S Warburton towards Rawlinna, *B.R. Maslin 5687*, 10.ix.1984 (CBG, PERTH).

NORTHERN TERRITORY: Haarst Bluff station, *P.K. Latz 7578*, 14.x.1977 (DNA, PERTH); Ayres Rock camping ground, *J.R. Maconochie 2536*, 30.ix.1979 (AD, BRI, DNA, MEL, NSW); 19 miles W Curtin Springs, *M. Lazarides 6177*, 8.x.1986 (AD, CANB, DNA, NSW); Uluru National Park, *M. Lazarides & J. Palmer 395*, 12.viii.1988 (CANB, DNA, MEL, NSW).

SOUTH AUSTRALIA: c. 185 km W Mabel Ck homestead, *N.N. Donner 3868*, 16.vii.1972 (AD); 44 km N Twins homestead, L.Eyre basin, *J.D.E. Whibley 6310*, 24.viii.1978 (AD); Serpentine Lakes, near Vokes Corner, 7 km E WA-SA Border, *J.Z. Weber 6467*, 26.viii.1980 (AD, NSW).

5b. **A. ayersiana** var. **latifolia** (J. Black)Randell, comb. nov.

Basionym: *A. aneura* var. *latifolia* J. Black, *Trans. Roy. Soc. S. Australia* 47:370 (1923).

Lectotype: Cobar [N.S.W.], *L. Abrahams 178*, -.ix.1910 (AD, lecto. here chosen, — leafy specimen with flowers, and drawings by J.M. Black of dissected flowers); isolecto.: (NSW!); syntypes: Ooldea [S.A.], *J. Black s.n.*, 24.ix.1920 (AD!); Ooldea [S.A.], *J. Black s.n.*, 27.ix.1920 (AD!).

Possible syntypes: Cobar [N.S.W.], *L. Abrahams 515*, -.ix.1910 (AD!); Cobar [N.S.W.], *J.B. Cleland s.n.*, 14.ix.1911 (AD!); Ooldea [S.A.], *S.A. White s.n.*, -.xii.1917 (AD!); Ooldea [S.A.], *sin. coll.*, -.viii.1918 (AD!); Broken Hill [N.S.W.], *E.H. Ising s.n.*, 18.x.1921 (AD!); Ooldea [S.A.], *Mrs Bates s.n.*, 2.v.1921 (AD!).

Description

Phyllodes 1.5-7 cm long, 4-10 mm wide (sometimes a few narrower on the same plant),

falcate, sometimes elliptic; phyllodes and stems persistently simple hairy, with opaque resin soon developing, often pruinose. Seedling phyllodes broader, with 3 veins conspicuous. Mature phyllodes rarely with a few branching veins and thus forming some reticulations. *Pods* 10-60 mm long, 5-25 mm wide, chartaceous, sparsely hairy between the transverse reticulate veins, oblong, sometimes resinous, green-brown; wing 0-1 mm wide variable, rarely obvious. *Seeds* small, 3-8 mm long, 2-7 mm wide, oval, glossy dark brown; areole area flat, paler; funicle terminal flat creamy. Broad-leaf mulga, umbrella mulga.

Illustrations: Fig. 1O, P; G.M. Cunningham et al. (1981, pp. 346, 347) as *A. aneura* var. *latifolia.*

Distribution and ecology

Found in all mainland states except Victoria. In Queensland and New South Wales this is the most common form encountered. It is often found in conjunction with other taxa of the group, growing in red sand or loam, rarely on rocky areas or watercourses. Map 8.

Notes

The protologue contains no reference to specimens nor localities. The lectotype has been selected from material which was either collected by Black, or bears annotations showing it to have been seen before the date of publication of the name. The specimens cited as "possible syntypes" bear no evidence of having been seen before that date, though they may well have been available to the author.

A very variable taxon, defined chiefly by the structure of the phyllodes. These are shorter than those of var. *ayersiana*, longer than those of *A. minyura*, and broader than those of *A. aneura*. However, it intergrades with *A. ayersiana* var. *ayersiana*, and narrower phyllode forms may be derived from hybridization with *A. aneura* var. *aneura*. Maslin suggests (*pers. comm.*) that Western Australian individuals with branching veins in the phyllodes may be hybrids derived from *A. craspedocarpa*.

It is very palatable and in times of drought is lopped to provide fodder for sheep and cattle.

Selected specimens (several hundred seen)

WESTERN AUSTRALIA: 5 miles [c. 8 km] W Meekatharra, *N.H. Speck 559*, 3.ix.1957 (CANB, MEL); 13.5 miles [c. 20 km] S Menzies towards Kalgoorlie, *B.R. Maslin 1941,* 11.viii.1971 (DNA); 11 km E Riverina homestead towards Menzies, *M.G. Corrick 9123,* 30.ix.1984 (MEL).

NORTHERN TERRITORY: 10 miles [c. 16 km] N Kulgera, *R.E. Winkworth 126*, 9.iii.1954 (CANB, MEL); Mulga Park homestead, c. 300 km SW Alice Springs, *P.G. Wilson 2339,* 30.vii.1962 (AD); Kathleen Spring, George Gill Ra., *A.C. Beauglehole 20502*, 10.x.1966 (DNA, MEL); c. 40 km WNW Alice Springs, *A.E. Orchard 682*, 5.vii.1968 (AD, DNA).

SOUTH AUSTRALIA: c. 100 km S Vokes Hill, c. 130 km N Cook, *T.R.N. Lothian 5695,* 20.vii.1972 (AD); 21 km W Mt Christy, Nullarbor Plain, *F.A. Mowling 66*, 27.ix.1976 (AD); 20.3 km from Balcanoona homestead, *L.D. Williams 11704*, 2.xi.1980 (AD); Mabel Creek, *M.F. Nobbs 1262*, 25.iv.1984 (AD); Balcanoona Ra., Gammon Ras Natl Park, *P.E. Conrick 1734*, 29.ix.1984 (AD, CANB).

QUEENSLAND: Boatman station, No 15 bore, *S.L. Everist 3095*, 18.vii.1947 (BRI, MEL); Hollymount Holdings, 34 miles [c. 55 km] W Westmar, Moonie hwy, *L. Pedley 908*, 19.xi.1961 (BRI, MEL); c. 16 miles [c. 25 km] NW Longreach, *S.L. Everist 7295*, 25.vii.1963 (BRI, MEL); c. 110 km SE Windorah towards Quilpie, *R.J. Henderson & D. Boyland H2111*, 16.ix.1973 (AD, BRI); Cooladdi, *D. Boyland 8062*, 9.x.1979 (DNA); 25 km W Bollon, *T. & J. Whaite 3814*, 25.viii.1981 (CBG, MEL, NSW).

NEW SOUTH WALES: 7 miles [c. 11 km] W Mazar station, near S.A. border, *E.F. Constable s.n.*, 24.vii.1955

NEW SOUTH WALES: 7 miles [c. 11 km] W Mazar station, near S.A. border, *E.F. Constable s.n.*, 24.vii.1955 (DNA); foothills Gunderbooka Ra., 56 km S Bourke, *E.F. Constable 4549*, 16.x.1963 (MEL, NSW); "Tundulya", c. 20 miles SE Louth, *C.W.E. Moore 3814*, 24.vii.1966 (CANB, MEL); Owens Gap, c. 9 miles [c. 14 km] W Scone, *C. Burgess s.n.*, 13.viii.1969 (CANB, MEL); Mootwingie Reserve, near camping area, *M.G. Corrick 5539*, 15.ix.1976 (MEL); 27.7 km from Bourke towards Nyngan, *N. Hall H78/88*, 21.ix.1978 (MEL).

6. **A. minyura** Randell, sp. nov.

A. ayersianae affinis sed phyllodiis brevioribus, ramulis phyllodiisque resinosissimus differt.

Holotype: 24 km E Ayres Rock, 30.ix.1979, *J.R. Maconochie 2539* (PERTH); iso.: (BRI!, DNA!, NSW!, B, CBG, G, HO, MO, PAUH, n.v.).

Description

Multi-stemmed shrub or small tree to 3 m high; growing points with dense simple and glandular hairs, these becoming dispersed as organs expand; however, all parts including unopened buds (but excluding reddish stipules and phyllode mucros) soon enveloped in thick droplets or layers of opaque resin. *Phyllodes* 1-2.5 cm long, 2-10 mm wide, elliptic to falcate, mucronate, hairy, with dense resin, grey but pale blue at branch tips due to opaque resin. *Inflorescence* oblong 6-20 mm long; peduncles 2-9 mm long, with simple and glandular hairs. *Pod* flat, 10-30 mm long, 6-16 mm wide, chartaceous, sparsely hairy between reticulate veins, oblong, brown; wing 1-2 mm wide, well developed; seed arrangement transverse. *Seed* small, oval, 4-5 mm long, 2-3 mm wide, glossy, gold to dark brown; areole area paler, usually sunken; funicle terminal creamy, flat. Desert form. Variant A of Maslin *(Flora of Central Australia).*

Illustrations: Fig. 1Q, R.

Distribution and ecology

Growing in red sand or earth, sometimes with laterite, from near the west coast in Western Australia, north and east to Alice Springs in Northern Territory and to 29°S in South Australia. Map 9.

Notes

This taxon may be recognised by the short broad phyllodes with dense resin cover, and the flat chartaceous winged pods. An important source of resin for Aborigines, from one of whose names for the plant the specific epithet is taken (Kean 1991 and voucher specimens).

Selected specimens (about 100 seen)

WESTERN AUSTRALIA: Barrow Ra., c. 120 km W of 3-state junction, *J.B. Cleland s.n.*, 25.vi.1958 (AD); Rawlinson Ra., S side below Circus Rock Holes, *J.M. Bechervaise & J. Kelso 128*, 11.v.1980 (MEL).

NORTHERN TERRITORY: Hamilton Downs station, *R.E. Winkworth 1354*, 21.ix.1955 (CANB, MEL); Victory Downs, c. 30 km SW Kulgera, *J.Z. Weber 116*, 27.x.1966 (AD); c. 11 km W Curtin Springs homestead, *N.N. Donner 4337*, 22.viii.1973 (AD, DNA); 21 km E Ayres Rock towards Curtin Springs, *B.G. Briggs 7161*, 30.ix.1979 (CBG, MEL, NSW).

SOUTH AUSTRALIA: Mt Moulden, far NW of S.A., *W.S. Reid 42*, 25.ix.1955 (AD); c. 100 miles [c. 160 km] S Mt Davies, Birksgate Ra., *J.B. Cleland s.n.*, 4.vii.1961 (AD); Emu-Dingo Claypan road, *W.S. Reid s.n.*, 5.vii.1967 (AD); 30 km SSE Fregon, *H. Haigh* sub *L.D. Williams 6532*, late Oct. 1974 (AD).

7. **A. craspedocarpa** F.Muell., *Chemist & Druggist Australasia New Ser. ii*:73 (1887)

Lectotype: Lake Austin [W.A.], *H.S. King s.n.* (NSW, lecto. here chosen, leafy specimen with attached pods); isolecto.: (MEL! 2 sheets, one of leafy shoots, the other of detached pods); syntype: between Yuin and Murchison R., *E. Giles s.n.*; (MEL!).

[Mueller also mentions a collection by Mr Winnecke from 'near Stuarts Ra.'. This collection is in MEL!, and falls within *A. minyura* Randell.]

Synonym

A. euphleba W. Fitzg., *J. West Australian Nat. Hist. Soc.* 2(1):16 (1904).

Lectotype: near Millys Soak, near Cue, Murchison R. District, *W.V. Fitzgerald s.n.*, .ix.1903 (NSW!, lecto. here chosen —a more complete specimen); isolecto.: (PERTH!).

Lectotypification seems desirable as both sheets were probably available to the author. The collection was unlikely to have been broken up in the short time before publication of the name.

Description

Rounded shrub or small tree to 8 m tall; bark grey fibrous; growing points covered with simple and glandular hairs, the latter very dense over young organs, becoming more dispersed as organs expand; phyllodes and stems finally with extensive opaque resin deposits. *Phyllodes* 1-5 cm long, 4-8 (-18 mm) wide, elliptic to obovate, sometimes falcate, with many conspicuous reticulate veins, densely white hairy, finally surface including hairs embedded in dense opaque resin; grey green. *Inflorescences* oblong, 8-22 mm long; peduncles 10-12 mm long, robust (1 mm diam.) with simple and glandular hairs. *Pod* 15-120 mm long, 8-40 mm wide; completely flat when young, at maturity crustaceous, slightly oval in section by the increased thickness of the valves, densely hairy with mixed simple and glandular hairs, except over raised conspicuous mostly transverse veins, whole surface finally with thick resinous cover; wing well developed 1-5 mm wide; seed arrangement transverse to slightly oblique. *Seeds* 7-12 mm long, 5-10 mm wide, thin, oval, glossy golden brown; areole area raised; funicle terminal. Camel bush, hop mulga or round-leaf mulga.

Illustrations: Fig. 1G; L.Diels & E.Pritzel (1904, p. 306).

Distribution and ecology

Grows only in arid areas of Western Australia, usually in red sand, clay, or loam or on rocky hillsides. Map 10.

Notes

The distinctive venation pattern of the phyllodes and the raised reticulate veins of the crustaceous pods make this taxon easily recognisable. Some of the seeds have an unusual flattened marginal rim 1 mm wide. Reported as a good fodder plant.

Topotype material of *A. euphleba* collected by Maiden (NSW, MEL) resembles *A. craspedocarpa* vegetatively with phyllodes only 3 cm long, but has massive pods 10-12 cm long and 2-4 cm wide, and seeds 10 mm long, 8 mm wide.

Selected specimens (about 50 seen)

WESTERN AUSTRALIA: 10 km NW Albion Downs homestead, *R.J. Chinnock 972*, 12.ix.1973 (AD, PERTH); 17 miles [c. 30 km] N Leonora, *C.A. Gardner 7951*, 18.x.1945 (MEL).

Excluded name

Acacia brachystachya Benth., *Fl. Austral.* 2:403 (1864); *A. aneura* var. *brachystachya* (Benth.)Maiden, *Wattles and Wattle-Barks edn 3*:61 (1906); *Racosperma brachystachyum* (Benth.)Pedley, *Austrobaileya* 2:345 (1987).

Lectotype: Mutanie Ras [Mootwingee, N.S.W., 3.i.1861, see Willis 1960], *Dr. Beckler s.n.* (MEL!, lecto. here chosen, — a leafy specimen with very young flowers, and without fruit, initialled as having been seen by Bentham); isolecto.: (K, n.v., fide Pedley, *Austrobaileya* 1(2):131 (1978) — without fruit, fide Bentham 1864).

This is not part of the same collection as the type of *A. aneura* var. *stenocarpa*. It was collected 2 months after that type, and at least 50 km distant.

The confusion surrounding this name derives from the occurrence of two sympatric taxa which, while having quite distinctive pods, are, to date, indistinguishable vegetatively and florally.

These taxa are:

A) flat-podded forms with transverse seeds; and
B) forms with pods oval in section, and with longitudinal seeds.

Within these two taxa, a number of type specimens have been designated. These are: within taxon A) *Acacia aneura*; within taxon B) *A. aneura* var. *stenocarpa*; *A. cibaria* (as lectotypified by Pedley 1978).

In addition, the type of *A. brachystachya* Benth. agrees vegetatively with both taxa A and B. However, it is without pods, so that, at this point in time, it cannot confidently be placed within either of these taxa.

Thus at this stage, *A. brachystachya* Benth. must be considered *nomen dubium*. It is excluded from this treatment.

Usage of the name "brachystachya"

Bentham described the taxon in 1864. Mueller (in Tate 1882), having noted that *A. aneura* and *A. brachystachya* Benth. are sympatric, and that flowering specimens cannot be readily distinguished (because "the length of the spike is variable"), decided that it seemed advisable to "abolish the latter specific name". He described *A. cibaria* to include forms with pods either oval in section or quite cylindrical, while flat-podded forms were left in *A. aneura*.

However, Mueller soon became convinced that at least two species were involved in *A. cibaria* (in Tate 1882, and mss notes on specimens, MEL). Later, plants with cylindrical pods were separated as *A. ramulosa* W.Fitzg. But the name *A. cibaria* F. Muell. was used for plants with oval-section pods until about 1915, by workers such as Bailey (1900) and Maiden (1906).

Later (e.g. in 1917b) Maiden decided that *A. brachystachya* was of the oval-pod type, but without giving reasons for his assumption. [My emphasis]. He then discussed the identity of *A. cibaria* F. Muell., deciding that it was a mixture of *A. brachystachya* sensu Maiden and *A. ramulosa* W. Fitzg. Consequently Maiden decided that the name *cibaria* "had better be dropped" (1917b).

Thus Mueller and Maiden had reached conflicting decisions about the usage of the name *brachystachya*, and neither of them could be vindicated by reference to the type material.

Since 1917, most published workers have followed Maiden, so that *A. cibaria* F. Muell. has virtually disappeared, to be replaced by *A. brachystachya* sensu Maiden, a name previously used only by Bentham. Maiden may have used the name consistently, but later workers have been less confident e.g. Maslin (1980) was not convinced of its distinction from *A. ramulosa* and Fox (1986) described it as having "flat thick phyllodes".

The consequences of this name change should be limited, as the species, though widespread, is relatively uncommon throughout its distribution. The name *A. brachystachya* sensu Maiden has been used consistently in New South Wales and Queensland, but here the distribution is restricted to far western areas. The taxon has a wider distribution in other states, but has not previously been studied in Western Australia, and the name was used with hesitation in South Australia.

Material without pods (i.e. not identifiable as either *A. aneura* or *A. cibaria*) may still be referred to *A. aneura* sens. lat.

Acknowledgements

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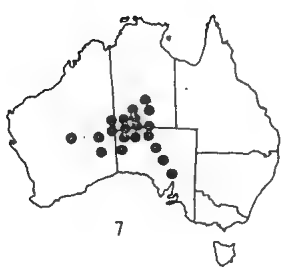

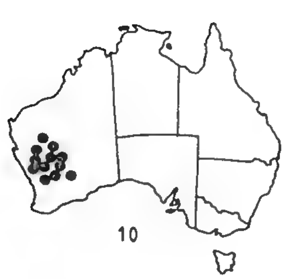

Maps 1-10. 1, *A. ramulosa* W. Fitzg.; 2. *A. paraneura* Randell; 3, *A. cibaria* F. Muell.; 4-5, *A. aneura* F. Muell. ex Benth.; 4, var. *aneura*; 5. var. *macrocarpa* Randell.; 6, *A. aneura* F. Muell. ex Benth. var. *conifera* Randell; 7-8, *A. ayersiana* Maconochie; 7, var. *ayersiana*; 8, var. *latifolia* (J. Black)Randell; 9, *A. minyura* Randell.; 10, *A. craspedocarpa* F. Muell.

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J. Adelaide Bot. Gard. (14)2: 133-168 (1992)

A TAXONOMIC REVISION OF THE GENUS *STACHYTARPHETA* VAHL (VERBENACEAE)* IN AUSTRALIA

Ahmad Abid Munir

State Herbarium, Botanic Garden,
North Terrace, Adelaide, South Australia 5000

Abstract

A taxonomic revision of *Stachytarpheta* in Australia is presented. The following six species, two of which are putative hybrids are recognised: *S. australis*, *S. cayennensis*, *S. jamaicensis*, *S. mutabilis*, *S. xadulterina* and *S. xtrimenii*. The putative hybrid *S. xtrimenii* is recorded from Australia for the first time. The following two species are typified: *S. cayennensis* and *S. mutabilis*. A range of material including specimens from South America and Malesia was examined.

Affinities and distribution are considered for the genus and each species. A key to the species and hybrid taxa is provided and a detailed description of each species is supplemented by a habit sketch of a flowering branch and analytical drawings of the flowers.

Taxonomic History of the Genus

The genus *Stachytarpheta* was described by Vahl (1804) with twelve South American species. It was placed in "Diandria Monogynia" where it was retained by Willdenow (1809), Roemer & Schultes (1817), Link (1821), Sprengel (1825), Dietrich (1839) and a few others. Persoon (1807) placed it in "Didynamia Angiospermia" and Reichenbach (1828) referred it and other related genera to the Labiatae. Within the "Diandria Monogynia", Link (1821) placed *Stachytarpheta* in the Verbenaceae, but misspelt it as "Stachytarpha". Later, the same spelling was used for this genus by Schauer (1847), Miquel (1858) and Thwaites (1861).

In 1829, Dumortier divided the Verbenaceae into two tribes: Verbeneae and Viticeae, with *Stachytarpheta* in the tribe Verbeneae. This tribe was accepted for the genus by Bartling (1830), Bentham (1839), Spach (1840), Schauer (1847) and Miquel (1858). Endlicher (1838) reunited *Stachytarpheta*, *Bouchea* and *Melasanthus* with *Verbena*. He also divided the family into three tribes: Lippieae, Lantaneae, and Aegiphileae, with *Stachytarpheta* and other related genera in the tribe Lippieae. This tribe was accepted for the genus by Meisner (1840) and Walpers (1845, 1847). In 1847, Schauer reclassified the Verbenaceae into three tribes: Verbeneae, Viticeae and Avicennieae, with *Stachytarpheta* in the tribe Verbeneae. He also split the genus into two sections: *Abena* and *Tarphostachys*, based chiefly on the thickness of their spikes, depressions in the rachis, shape of corolla, length of calyx and corolla-tube and the protrusion of style above the corolla-tube. Schauer (1847) further subdivided the section *Abena* into two subsections: *Lepturae* and *Pachyurae*, and section *Tarphostachys* into four subsections: *Longispicatae*, *Brevispicatae*, *Subspicatae* and *Capitatae*. These sections and subsections were adopted by Moldenke (1959, 1971). Bentham (1876) divided the Verbenaceae into eight tribes, with *Stachytarpheta* in the tribe Verbeneae. This tribe was accepted for the genus by C.B. Clarke (1885), Durand (1888), Bailey (1901, 1913), King & Gamble (1909), Ridley (1923), Lémée (1943) and a few others.

*The present treatment of the genus *Stachytarpheta* is the eleventh in the series of taxonomic revisions in the family Verbenaceae in Australia. (See Munir, 1982, 1984a, 1984b, 1985, 1987a, 1987b, 1989, 1990a, 1990b, 1991).

In 1895, Briquet reclassified the Verbenaceae and upgraded the tribe Verbeneae to a subfamily Verbenoideae. The latter consisted of six tribes with *Stachytarpheta* in the tribe Lantaneae. This classification was adopted by Dalla Torre & Harms (1904), H.J. Lam (1919), Junell (1934), Moldenke (1959, 1971), Melchior (1964), Lopez-Placios (1977) and Raj (1983). In the same treatment, Briquet (1895) divided the genus *Stachytarpheta* into two sections: *Abena* and *Melasanthus* (Sect. *Tarphostachys* Schauer), each characterised chiefly by the arrangement of flowers and bracts in a spike, angular or terete rachis, size of depressions in the rachis and presence or absence of scale-like bracts. He further subdivided the section *Melasanthus* into four subsections, previously proposed by Schauer (1847) for the section *Tarphostachys*. These sections and subsections were adopted by Dalla Torre & Harms (1904). The majority of botanists, however have not divided this genus into sections or subsections, but have retained it in the Verbenaceae without reference to any subfamily or a tribe. In view of the sectional division of the genus by Schauer (1847) and Briquet (1895), the majority of Australian species seem to belong to the section *Abena*. The study of the few Australian species, however, does not allow speculation on the supra- and infra-generic structure of the genus.

Australian History of the Genus

The first Australian record of naturalised *Stachytarpheta* was made by Bailey (1883, 1890) who listed *S. jamaicensis* from Queensland. Subsequently, Bailey (1901, 1913) published another two naturalised species *S. dichotoma* and *S. mutabilis* from Queensland but without any mention of *S. jamaicensis*. In 1917, Ewart & Davies for the first time recorded *S. dichotoma* from Northern Territory. The first comprehensive list of naturalised *Stachytarpheta* taxa in Australia was published by Moldenke (1959) who listed one hybrid and three species namely *S.* ×*adulterina*, *S. jamaicensis*, *S. mutabilis* and *S. urticaefolia*. Burbidge (1963) mentioned 3-4 naturalised species from the north-east and south-east of Queensland. In 1971, Moldenke added *S. australis* to his previous records. In 1972, Chippendale reported two species from the Northern Territory: *S. dichotoma* and *S. jamaicensis*. Subsequently, Moldenke (1980) maintained the number of taxa in Australia to five but replaced *S. australis* with *S. dichotoma*. Stanley (1986) recorded three species from south-eastern Queensland: *S. cayennensis*, *S. jamaicensis* and *S. mutabilis*. Recently, Dunlop (1987) listed four species from Northern Territory: *S. cayennensis*, *S. jamaicensis*, *S. dichotoma* and *S. urticaefolia*. In the present revision of *Stachytarpheta* in Australia, the following four species and two hybrids are recognised: *S. australis*, *S. cayennensis*, *S. jamaicensis*, *S. mutabilis*, *S.* ×*adulterina* and *S.* ×*trimeni*.

STACHYTARPHETA M. Vahl, nom. cons.

Stachytarpheta M. Vahl, Enum. Pl. 1 (1804) 205; Pers., Syn. Pl. 2 (1807) 139, no. 1228; Willd., Enum. Pl. Hort. Berol. (1809) 30; Kunth, Nov. Gen. 2 (1817) 279; Roemer & Schultes, Syst. Veg. 1 (1817) 57; Link, Enum. Hort. Berol. 1 (1821) 18 —"Stachytarpha"; Sprengel, Syst. Veg. 1 (1825) 53; Reichb., Consp. Reg. Veg. part 1 (1828) 117, no. 2896; Dumort., Anal. Fam. Pl. (1829) 22; Bartling, Ord. Nat. Pl. (1830) 180; Endl., Gen. Pl. 1 (1838) 633, no. 3685a; D. Dietr., Synop. Pl. Vol. 1 (1839) 32, 99; Meissner, Pl. Vasc. Gen. Vol. 1, "Tab. Diag." (1840) 290; Vol. 2, "Commentarius" (1840) 198; Walp., Repert. Bot. Syst. 4 (1845) 4; Schauer in A. DC., Prod. 11 (1847) 561 —"Stachytarpha"; Walp., Repert. Bot. Syst. 6 (1847) 686; Miq., Fl. Ind. Bat. 2 (1858) 907 — "Stachytarpha"; Thwaites, Enum. Pl. Zeyl. (1861) 241 —"Stachytarpha"; Pfeiffer, Nom. Bot. 2 (1874) 1256; Benth. in Benth & Hook.f., Gen. Pl. 2 (1876) 1145; Bailey, Synop. Qld Fl. (1883) 376; Briq. in Engl. & Prantl, Pflanzenfam. 4, 3a (1895) 154; Bailey, Qld Fl. 4 (1901) 1172; Dalla Torre & Harms, Gen. Siphon. (1904) 430, no. 7151; King & Gamble, Mat. Fl. Malay. Penins. 4 (1909) 1008; Bailey, Comp. Cat. Qld. Pl. (1913) 382; H.J. Lam, Verbenac. Malay. Archip. (1919) 19; Ridley, Fl. Mal. Penins. 2 (1923) 613; Danser, Ann. Jard. Bot. Buitenzorg. 40

(1929) 1-43; F. Went, Ann. Jard. Bot. Buitenzorg. 43 (1933) 1-24; Fedde, Just's Bot. Jahresber 57 (1938) 890 — "Stachytarphetha"; Mold., Lilloa 4 (1939) 298; Mold. in Pulle (ed.), Fl. Suriname 4 (1940) 271; Publ. Carnegie Inst. Wash. No. 522 (1940) 177; Lemée, Dict. Descrip. Syn. Gen. Pl. Phan. 6 (1935) 248; ib. 8b (1943) 653; Steyerm., Bol. Soc. Venez. Ci. Nat. 10 (1946) 279 — "Stachytarphaeta"; Brenan, Kew Bull. No. 2 (1950) 223; Mold. in Humbert, Fl. Madagascar (1956) 20; Mold., Résumé Verbenac. etc. (1959) 227, 277, 320, 344, 353, 356, 379; Angely, Liv. Gen. Bot. Bras. (1960) 35, 55 — "Stachytarphetta"; J.F. Macbr., Fl. Peru (1960) 657; N. Burb., Dic. Aust. pl. Gen. (1963) 278; Backer & Bakh.f., Fl. Java 2 (1965) 597; Gooding et al., Fl. Barbados (1965) 363; T. Cooke, Fl. Pres. Bombay 2, repr. edn (1967) 500; D. Gibson in Stanley & L.O. Williams, Fl. Guatemala (1970) 224; Mold., Fifth Summary Verbenac. etc. 1 & 2 (1971) 377, 473, 571, 620, 626, 640, 647, 708; Adams, Fl. Pl. Jamaica (1972) 631; Mold., Ann. Missouri Bot. Gard. 60 (1973) 73; Lopez-Pal., Fl. Venezuela Verbenac. (1977) 512; Mold. in Dassan. & Fosb. (eds), Fl. Ceylon 4 (1983) 246; Ros Fernandes, Bol. Soc. Sér. 2, 57 (1984) 87-111; Stanley in Stanley & Ross, Fl. S.E. Qld 2 (1986) 366; Jansen-Jacobs, Fl. Guianas, part 4 (1988) 65; R. Howard, Fl. Lesser Antilles, part 3 (1989) 238; Wagner et al., Man. Fl. Pl. Hawaii 2 (1990) 1321.

Type species: *S. jamaicensis* (L.)M. Vahl, Enum. Pl. 1 (1804) 206, based on *Verbena jamaicensis* L., Sp. Pl. edn 1, 1 (1753) 19., "*typ. cons*".

Sherardia Adans., Fam. Pl. 2 (1763) 198, not *Sherardia* L., 1753, nor Dill. 1754, nor Miller 1759, nor Boehmer 1760.
Type species: non designatus.

Valerianoides Medikus, Phil. Bot. 1 (1789) 177, *nom. rejic.*; Britton & Wilson, Sci. Surv. Puerto Rico & Virgin Isl. 6 (1925) 143; Kuntze, Rev. Gen. Pl. 1 (1891) 509 — "Valerianodes"; Britton, Fl. Bermuda (1918) 313 — "Valerianodes".
Type species: *Verbena jamaicensis* L.

Abena Necker, Elem. Bot. 1 (1790) 296; Hitchc., Ann. Rep. Missouri Bot. Gard. 4 (1893) 117.
Type species: non designatus.

Vermicularia Moench, Meth. Suppl. (1802) 150, *nom. rejic.*, not *Vermicularia* Tode 1790.
Type species: *V. decurrens* Moench, loc. cit. & *V. lancifolia* Moench, loc. cit.

Cymburus Salisb., Parad. Lond. Pl. (1806) 49.
Type species: *C. mutabilis* (Jacq.)Salisb. loc. cit., based on *Verbena mutabilis* Jacq., Collectanea 2 (1789) 334.

Melasanthus Pohl, Pl. Bras. Ic. 1 (1827) 75, t. 60.
Type species: non designatus.

Tarpheta Raf., Fl. Tellur. 2 (1837) 103.
Type species: non designatus.

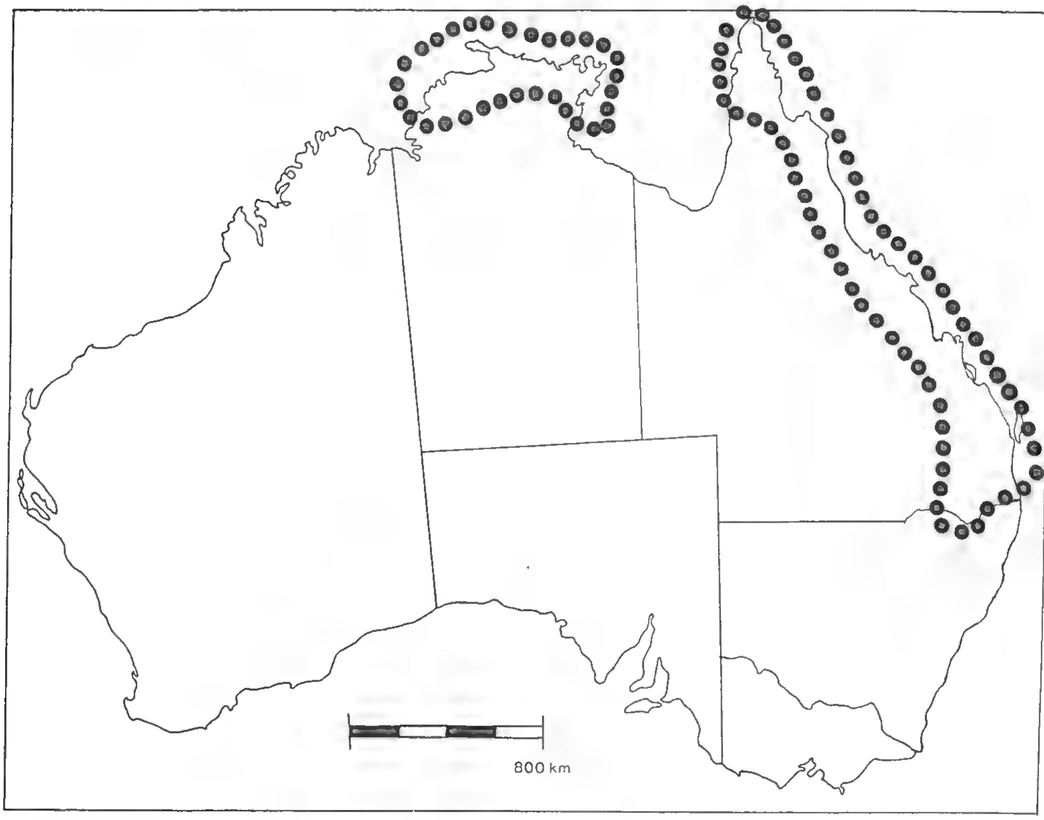
Herbs or low shrubs, glabrous or variously pubescent to tomentose with simple hairs. *Stem* and branches almost terete or tetragonal. *Leaves* simple, mostly decussate-opposite, petiolate or sometimes subsessile, the lamina dentate to serrate, somewhat rugose. *Inflorescence* terminal, spicate, pedunculate; spikes mostly elongate, indeterminate, (sometimes short in non-Australian species), densely or loosely flowered. *Flowers* bracteate, sessile or semi-immersed in depressions or furrows in the rachis of the spike, zygomorphic, bisexual, hypogynous, each flower solitary in the axil of a bract; bracts small, sessile. *Calyx* persistent, tubular, 5-lobed or 5-dentate at the apex, each ridged, the teeth equal or unequal, usually not accrescent. *Corolla* deciduous, tubular below, 5-lobed; tube cylindric, straight or curved, slender throughout or broadened apically; lobes sub-equal, spreading, often orbicular, obtuse or retuse at the apex. *Stamens* 4, included, inserted above the middle of the corolla-tube, the anterior 2 fertile, with small filaments and unappendaged anthers, the posterior (or lateral) 2 sterile, reduced to small staminodes. *Ovary* bicarpellary, syncarpous, 2-locular, each with one parietal ovule; style elongate, filiform, with capitate

stigma. *Fruit* a schizocarp, oblong-linear, enclosed in fruiting-calyx, splitting at maturity into 2 hard mericarps each 1-seeded. *Seeds* linear, without endosperm.

Number of species: World ± 65 species and many infraspecific and hybrid taxa; Australia: 6 species, 2 of which are putative hybrids, introduced from tropical America but now naturalised in Australia.

Derivation of name

The generic name is derived from the Greek *stachys*, a spike; *tarpheios*, thick; referring to the thick flower spikes of these plants.



Map 1. Distribution of the genus *Stachytarpheta* Vahl in Australia

Distribution (Map 1)

The genus *Stachytarpheta* is widely distributed in tropical and subtropical America, with a few species (mostly naturalised) in tropical and subtropical Australia, Asia, Africa and Oceania.

In Australia six species have been introduced and are now naturalised in the coastal areas

of Queensland and Northern Territory. All of them are also known from Papua New Guinea and neighbouring Indonesian Islands. One species, *S. jamaicensis* (L.)M. Vahl, is the most widespread in the whole genus and has been recorded from both tropical and subtropical America and introduced in several countries of the world.

Comments

The original spelling of the genus was *Stachytarpheta*. Link (1821) amended it to "*Stachytarpha*" and subsequently the same spelling was used by Schauer (1847) and a few others. This may be a technical improvement, but cannot be upheld under the Rules. In fact, the genus has been variously spelled by different botanists namely "*Stachytarpha*", "*Stachytarpenta*", "*Stachytarpetha*", "*Stachytarphaeta*", "*Stachytarfetta*", "*Stachytarphetha*" and "*Stachytarpheia*". None of these orthographic variants can supersede the validly published original spelling of this genus.

The year of publication for *Stachytarpheta* has been recorded by several botanists as "1805". According to Stafleu & Cowan (1986), however, the first volume of Vahl's Enumeratio Plantarum, where this genus originally appeared was published on 4th July 1804, and the second volume on 15th October 1805.

The type species of the genus was recorded by Péi (1932) and Moldenke (1940) as *S. angustifolia* (Miller)M. Vahl, which is based on *Verbena angustifolia* Miller. [Gard. Dic. edn 8 (1768) no. 15]. In the Index Nominum Genericorum (Plantarum) 1979, however, *S. jamaicensis* (L.)M. Vahl is given as the "typ. cons.", which is based on *Verbena jamaicensis* L. [Sp. Pl. edn 1, 1 (1753) 19]. The majority of botanists have accepted *S. jamaicensis* as the type of this genus because it is based on the oldest validly published basionym.

In Australia, all *Stachytarpheta* species are naturalised and most of them are cultivated as ornamental or hedge plants.

Moldenke (1959, 1971) strongly suggested (1971, p. 744) that the genus *Stachytarpheta* and other closely related genera "probably ought to be split into several genera each through the elevation in rank of present subgeneric groupings". In the same publication (p. 791) he again pointed out "that at least some of the present subgeneric groupings in *Premna*, *Stachytarpheta* ... ought to be raised to generic status".

Several infraspecific taxa have been described from outside Australia for the species treated in this paper. Since I have not been able to distinguish them clearly from the typical forms, infraspecific taxa were ignored for this Australian treatment of the genus.

According to Backer & Bakhuizen (1965), "only few flowers of a same spike are open simultaneously. They are ephemerous, expanding in the early morning, falling off in the afternoon of the same day. Moreover they are traumatochorous, that is, after a spike or a flower has been separated from the plant the unfaded corolla is shed within a few minutes. When collecting and identifying the plant, one should take notice of this fact. If a cut stem is placed in water in time new flowers will expand the following morning".

Cytological studies in the genus seems to have been carried out in only a few species. According to Fedorov (1974), the number of chromosomes known in the genus ranges from 2n = 48 in *S. cayennensis* to 2n = 160 in *S. indica.*

Where two or more species of this genus grow together hybrids often occur. In Australia, the following two hybrids have been found in the wild: *S.* x*adulterina* Urb. & E. Ekman (*S. jamaicensis* x *S. mutabilis*) and *S.* x*trimenii* Rich. (*S. cayennensis* x *S. mutabilis*).

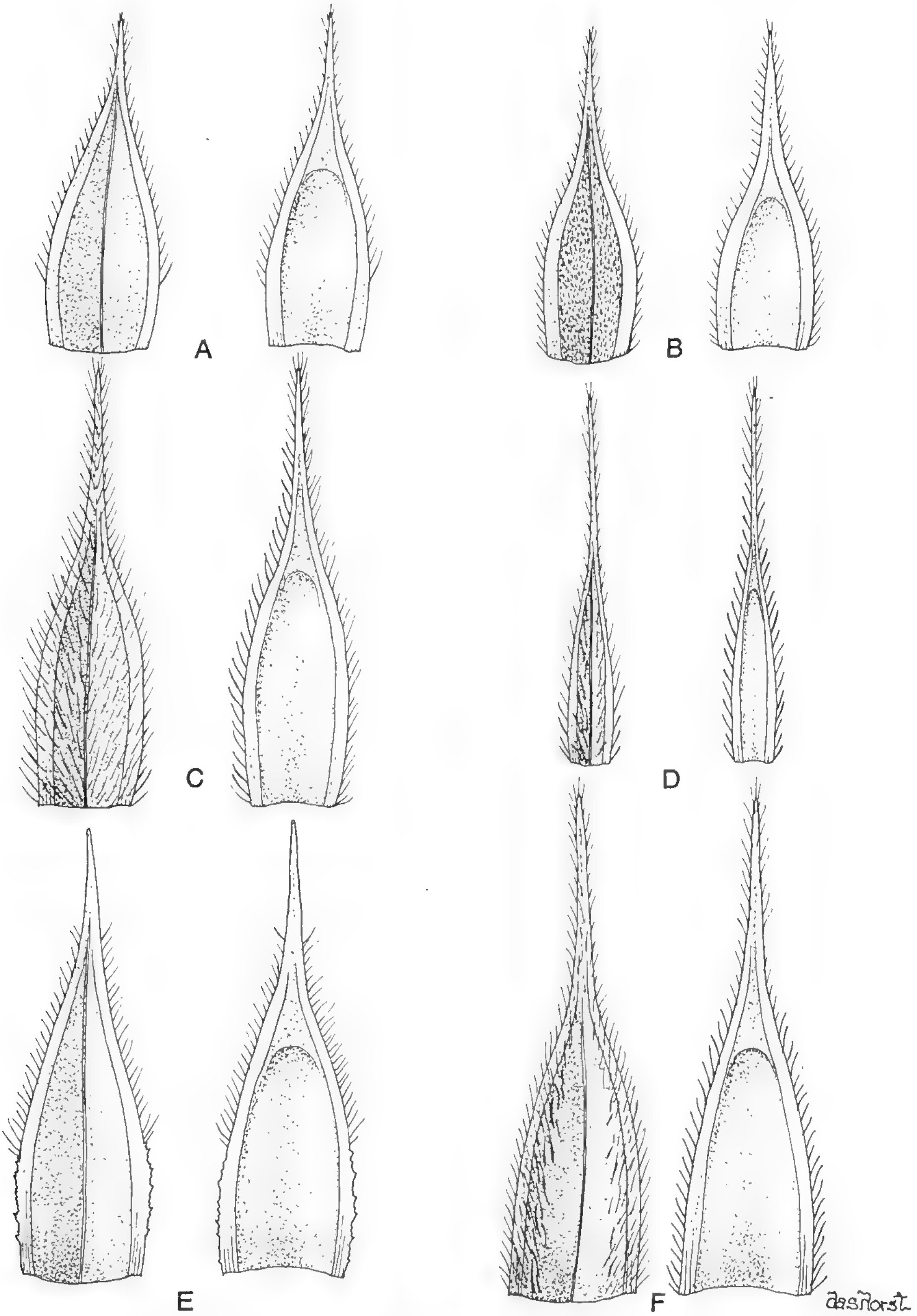


Fig. 1. Range of flower bracts showing respectively abaxial and adaxial views: A, *S. jamaicensis* (L.)M. Vahl, *S.T. Blake 23537*: L; B, *S. cayennensis* (Rich.)M. Vahl, *S.L. Everist 5081*: BRI; C, *S. mutabilis* (Jacq.)M. Vahl, *J.R. Clarkson 7262*: AD; D, *S. australis* Mold., *S. Pickering 2*: DNA; E, *S.* x*adulterina* Urb. & E. Ekman, *N.L. Britton 3241*: NY, holotype; F, *S.* x*trimenii* Rech., *L.J. Brass 33493*: BRI.

The term peduncle used in this paper is for the naked basal part of the inflorescence (spike) between the upper-most pair of leaves and the lower-most flowers and bracts on the rachis. The calyx of *Stachytarpheta* is shortly bilobed with two larger and one smaller central tooth above and two larger ones below. Sometimes, the small dorsal tooth opposite to the axis is minute or absent.

In almost all Australian species, the hairs, when present, are mostly septate.

Affinities

Stachytarpheta is closely related to *Aloysia* Ortega ex Pers. and *Bouchea* Cham. in its leaves being simple; inflorescence spicate; calyx much longer than broad, easily visible; ovary bilocular and fruit comprising 2 mericarps. Nevertheless, *Stachytarpheta* may easily be distinguished by its perfect stamens being 2, with a posterior pair of staminodes; axis of spike (i.e. rachis) with furrows or depressions and anther-loculi widely divergent in the lower half.

Palynological investigation by Raj (1983) showed that the pollen grains of *Stachytarpheta* and *Bouchea* resemble each other very closely. Both are 3-colpate with an exine sculpture made up of verrucae (warts), which distinguishes them from the remaining genera of the family.

Key to the species

1a. Lower leaf surface, rachis and calyx pubescent or densely tomentose. Mature rachis tends to be glabrescent in *S.* x*adulterina* and *S.* x*trimenii* 3

b. Lower leaf surface, rachis and calyx glabrous or leaf-blades glabrous but sparsely strigose on veins below 2

2a. Rachis stout and firm, (2-) 3-5 (-7) mm diam.; furrows from the immersed flowers narrower than the rachis; leaves somewhat fleshy; bracts 4-8 x 1.5-2.5 mm .... 1. *S. jamaicensis*

b. Rachis slender and erect to flexuose, 1-3 mm diam.; furrows from the immersed flowers nearly as wide as the rachis; leaves memberanous; bracts 3-5 x 1-2 mm .... 2. *S. cayennensis*

3a. Lower leaf surface densely tomentose; spikes 6-8 (-10) mm diam. without open flowers, tomentose; bracts 8-12 x 2-3 mm; corolla red or bright rose-pink, the limbs exceeding 12 mm across ... 3. *S. mutabilis*

b. Lower leaf surface pubescent or strigose; spikes 2-5 (-6) mm diam. without open flowers, pubescent or glabrescent; bracts 4-8 (-9) x 0.5-2 mm; corolla blue, purplish-blue or violet, the limbs not exceeding 10 mm across 4

4a. Bracts subulate to linear-lanceolate, pubescent abaxially, 4-5 x 0.5-1 mm; calyx 4-6 mm long; corolla pale blue or whitish-mauve .... 4. *S. australis*

b. Bracts oblong-ovate, glabrous or sparsely pubescent abaxially, 7-9 x 2 mm; calyx 8-10 mm long; corolla purplish-blue, pinkish-lilac or violet-purple 5

5a. Spikes c. 10 mm diam. after anthesis; rachis 3-4.5 mm diam.; bracts glabrous except ciliate margin; calyx equally 4-toothed .... 5. *S.* x*adulterina*

b. Spikes less than 10 mm diam. after anthesis; rachis 2.5-3 (-3.5) mm diam.; bracts sparsely pubescent to glabrescent abaxially; calyx unequally 4-toothed .... 6. *S.* x*trimenii*

1. **Stachytarpheta jamaicensis** (L.)M. Vahl, Enum. Pl. 1 (1804) 206; Sims, Curtis's Bot. Mag. 44 (1817) t. 1860; Walp., Rep. Bot. Syst. 4 (1845) 4; Schauer in DC., Prod. 11 (1847) 564; Miq., Fl. Ind. Bat. 2 (1858) 907; Bailey, Synop. Qld Fl. (1883) 376; Bailey, Cat. Indig.

& Nat. Pl. Qld (1890) 35; Briq. in Engl. & Prantl, Nat. Pflanzenfam. 4, 3a (1895) 154; King & Gamble, Mat. Fl. Malay. Pen. 4 (1909) 1008; H.J. Lam, Verbenac. Malay. Archip. (1919) 22, p.p., excl. syn. *S. indica* (L.)M. Vahl; H.J. Lam in H.J. Lam & Bakh., Bull. Jard. Bot. Buitenzorg Ser. 3, 2 (1921) 6, p.p., excl. syn. var. *indica* H.J. Lam; Bakh. & H.J. Lam, Bull. Jard. Bot. Buitenzorg Ser. 3, 4 (1922) 283; Merr., Enum. Philip. Fl. Pl. 3 (1923) 381, p.p., excl. syn. *S. indica* (L.)M. Vahl & *Verbena indica* L.; Ridley, Fl. Mal. Penin. 2 (1923) 613; Danser, Ann. Jard. Bot. Buitenzorg 40 (1929) 7-9; Péi, Verbenac. China (1932) 11, p.p., excl. syn. *S. indica* (L.)M. Vahl; F. Went, Ann. Jard. Bat. Buitenzorg 43 (1933) 2-3, fig. 2 & 3; Fletcher, Kew Bull. Misc. Inform. No. 10 (1938) 404, 411, p.p., excl. syn. *S. indica* (L.)M. Vahl; Mold., Lilloa 4 (1939) 300; Publ. Carnegie Inst. Wash. No. 522 (1940) 179; in Pulle (ed.), Fl. Suriname 4 (1940) 276; Brenan, Kew Bull. 1950 (1951) 223-226; Mold., Fl. Madag. Fam. 174 (1956) 22, fig. III, 1-2; Leon & Alain, Fl. Cuba 4 (1957) 296, fig. 126B; Mold., Résumé Verbenac. etc. (1959) 210, 469; Backer & Bakh.f., Fl. Java 2 (1965) 598; Gooding et al., Fl. Barbados (1965) 363; D. Gibson in Stanley & L.O. Williams (eds), Fl. Guatemala (1970) 227; Mold., Fifth Summary Verbenac. etc. 1 & 2 (1971) 348, 908; Adams, Fl. Pl. Jamaica (1972) 632; Mold., Ann. Missouri Bot. Gard. 60 (1973) 74; H. St. John, List & Summary Fl. Pl. Hawaii Isl. (1973) 291; López-Pal., Revista Fac. Farm. Univ. Los Andes Merida No. 15 (1974) 82; Mold., Phytologia 28 (1974) 433; López-Pal., Fl. Venezuela Verbenac. (1977) 531; Mold., Sixth Summary Verbenac. etc. (1980) 327, 329, 330, 332, 339, 340-343, 575; in Dassan. & Fosb., Fl. Ceylon 4 (1983) 253; Raj, Rev. Palaeobot. Palynol. 39 (1983) 352, 365, 398; Ros. Fernandes, Bol. Soc. Brot. Ser. 2, 57 (1984) 100; Stanley in Stanley & Ross, Fl. S.E. Qld 2 (1986) 366, fig. 51G; Dunlop, Checklist Vasc. Pl. N.T. (1987) 80; Jansen-Jacobs in Görts-Van Rijn (ed.), Fl. Guianas 4 (1988) 69, fig. 20; Howard, Fl. Lesser Antilles 6, part 3 (1989) 239, fig. 97; Wagner et al., Man. Fl. Pl. Hawaii 2 (1990) 1322.

Lectotype: *P. Browne s.n.*, Jamaica in the herbarium of Linnaeus (S, microfiche no. 7.13 lectotype!; S, fiche 7.9 & 7.11, LINN 35.2 —isolectotypes!. Lectotypification was made by Ros. Fernandes in Bol. Soc. Brot. Sér. 2, 57 (1984) 96-98.

Verbena jamaicensis L., Sp. Pl. edn 1 (1753) 19 **basionym**; Jacq., Observ. 4 (1771) 6, t. 85; Willd., Sp. Pl. edn 4, 1 (1797) 115.
Type: As for *Stachytarpheta jamaicensis* (L.)M. Vahl.

Abena jamaicensis (L.)A. Hitchc., Ann. Rep. Missouri Bot. Gard. 4 (1893) 117.
Type: As for *Stachytarpheta jamaicensis* (L.)M. Vahl.

Stachytarpheta bogoriensis Zoll. & Moritzi in Moritzi, Syst. Verz. Zoll. (1845) 52.
Type: "In glareosis et dumitis prope Bogor (Buitenzorg) (P, n.v.).

S. friedrichsthalii Hayek, Feddes Repert. Sp. Nov. 3 (1907) 273.
Types: *Friedrichsthal 466*, St Juan de Nicaragua, Central America (GB, syntype, n.v.); *Fendler 219*, Charges, Isthamus of Panama, Central America (GB, syntype, n.v.).

S. indica sensu Schauer in DC., Prodr. 11 (1847) 564, p.p.; Miq, Fl. Ind. Bat. 2 (1856) 907, p.p.; C.B. Clarke in Hook.f., Fl. Br. Ind. 4 (1885) 564, p.p. quoad syn. *S. jamaicensis* (L.)M. Vahl, *S. villosa* Turcz. and *Verbena jamaicensis* L.; Baker in Dyer, Fl. Trop. Afr. 5 (1900) 284, p.p. excl. spec. *Scott Elliot 4162*; Danser, Ann. Jard. Bot. Buitenzorg 40 (1929) 5; Brenan, Kew Bull. 1950 (1951) 225, p.p.; Hutch. & Dalziel in Hepper (ed.), Fl. W. Trop. Afr. edn 2, 2 (1963) 434, p.p. quoad spec. *Mann 89*, *Scott Elliot 3833*, *T. Vogel 30* and fig. 305M to R.

S. indica var. *jamaicensis* (L.)Razi, J. Mysore Univ. 7 (1946) 63.
Type: As for *Stachytarpheta jamaicensis* (L.)M. Vahl.

S. jamaicensis f. *albiflora* Standley, Field Mus. Bot. 4 (1929) 320.
Type: *P.C. Standley 53814*, in sandy thicket along the beach, Tela, Dept. Atlantida, Honduras, 28.xii.1927 (F 583934, n.v.).

S. marginata M. Vahl, Enum. Pl. 1 (1804) 207; Pers., Synop. Pl. 2 (1806) 139.
Type: *Rohr s.n.*, India Occidentali (C, n.v.).

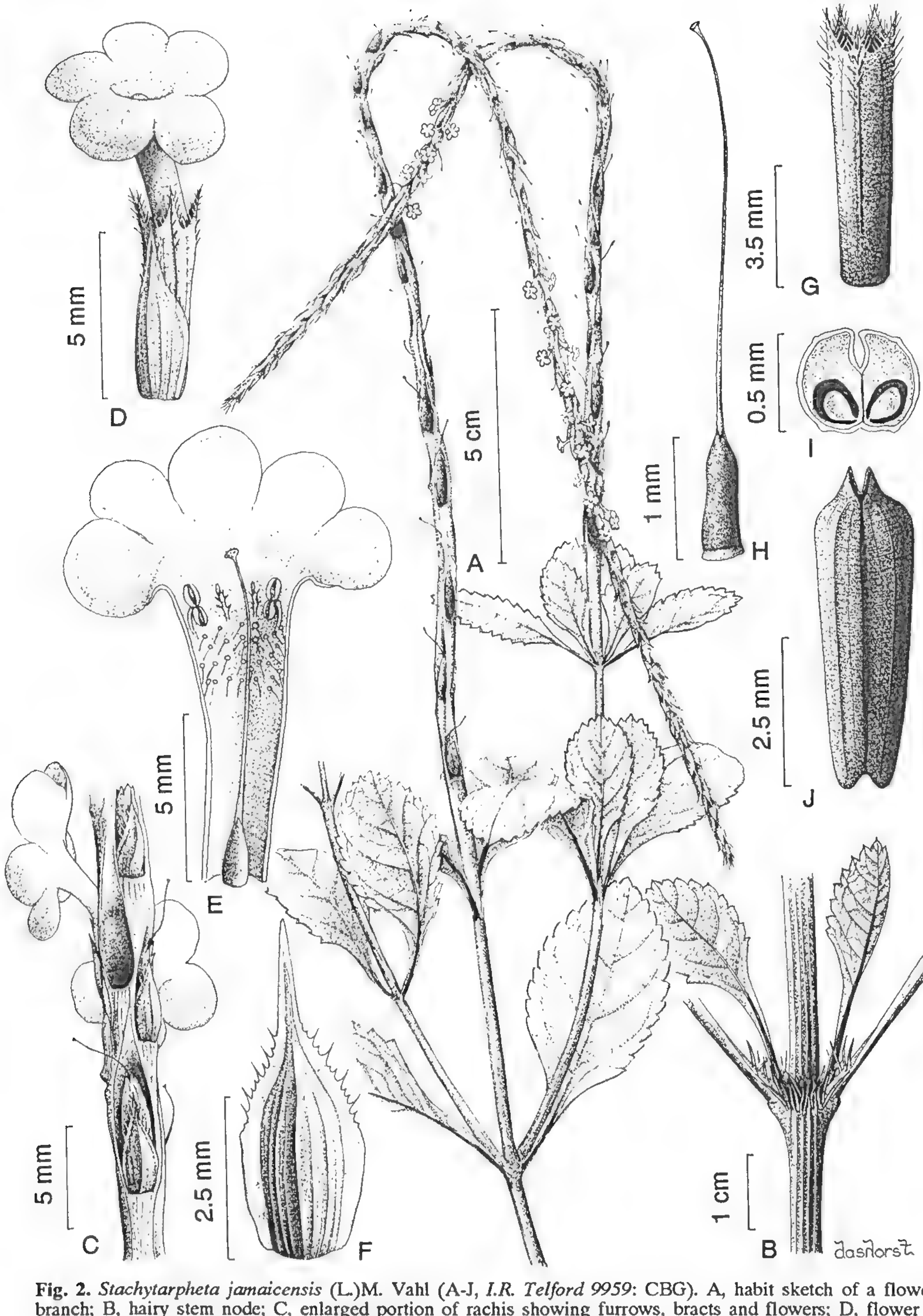


Fig. 2. *Stachytarpheta jamaicensis* (L.)M. Vahl (A-J, *I.R. Telford 9959*: CBG). A, habit sketch of a flowering branch; B, hairy stem node; C, enlarged portion of rachis showing furrows, bracts and flowers; D, flower with bract; E, cut open flower showing androecium, gynoecium and hairy corolla-throat; F, flower-bract; G, calyx; H, gynoecium; I, transverse section of ovary; J, fruit.

S. pilosiuscula Kunth, Nov. Gen. & Sp. Pl. 2 (1817) 279.
Type: "Crescit in ripa Orinoci juxta urbem Angustora" (P, n.v.).

S. surinamensis Miq. ex Pulle; Enum. Vasc. Pl. Surinam (1906) 402.
Type: ?U, n.v.

S. villosa, Turcz., Bull. Soc. Nat. Mosc. 36 (1863) 197.
Type: *Porrotet 407*, Pondichery, India (KW, n.v.).

Valerianodes jamaicense (L.)Kuntze, Rev. Gen. Pl. 2 (1891) 509; Britton, Fl. Bermuda, repr. edn (1965) 313, fig. 334; Britton & Millsp., Bahama Fl. (1920) 366; Britton & P. Wilson, Sci. Surv. Puerto Rico & Virgin Isls 6 (1925) 144.
Type: As for *Stachytarpheta jamaicensis* (L.)M. Vahl.

V. jamaicense var. *indicum* (L.)Kuntze f. *glabrum* Kuntze, Rev. Gen. Pl. 2 (1891) 510.
Type: Trinidad, Puerto Rico (NY, n.v.).

V. jamaicense var. *spathulatum* Kuntze, Rev. Gen. Pl. 2 (1891) 510.
Type: Port Lemon, Costa Rica (NY, n.v.).

Vermicularia decurrens Moench, Suppl. Meth. Pl. (1802) 150.
Type: Unknown. "No longer extant" (Stafleu & Cowan, 1981).

Zapania jamaicensis (L.)Lam., Tab. Encycl. Méth. Bot. 1 (1791) 59; J. St. Hill, Expos. Fam. 1 (1805) 250.
Type: As for *Stachytarpheta jamaicensis* (L.)M. Vahl.

Description (Fig. 1A & 2)

Low sprawling herb or small shrub, (20-) 50-120 (-200) cm tall, c. 1 m diameter, often purplish throughout. *Stem* dichotomously branched, terete or obscurely tetragonal, usually glabrous except for the lanuginous-pilose nodes, often purplish or yellowish-brown. *Leaves* opposite, subsessile to shortly petiolate, green; lamina obovate to oblong-elliptic, (20-) 30-80 (-100) mm long, (10-) 20-45 (-50) mm wide, coarsely serrate-dentate, somewhat obtuse at the apex, more or less decurrent or attenuate into the petiole, often bluish, greyish-green or dark green above, paler below, somewhat fleshy or succulent when fresh, membranous-chartaceous or subcoriaceous in drying, glabrous or sometimes sparsely hairy on the veins below; petiole 5-20 (-30) mm long, glabrous. *Spikes* terete, stout, often flexuous, (15-) 20-45 (-50) cm long; rachis thick, glabrous, (2-) 3-5 (-7) mm diam., the furrows of the half-immersed flowers much narrower than the mature rachis; peduncle short, glabrous, (5-) 10-25 (-35) mm long. *Flowers* sessile, bracteate, at first erect, later immersed in the thickened rachis; bracts narrowly ovate-elliptic or oblong-lanceolate, almost as long as the calyx, 4-6 (-8) mm long, 1.5-2.5 mm wide at base, glabrous, striate, scabrous, with scarious and obscurely ciliate margins, setaceous-acuminate at apex. *Calyx* completely embedded in rachis furrows, somewhat compressed, 5-7 mm long, 1.5-2 mm wide, glabrous except some short pubescence near the apex, the rim bilobed with 4 equal teeth and 1 small tooth, the teeth triangular-ovate. *Corolla* pale mauve-blue, violet or purple, hypocrateriform, glabrous outside, with sparsely gland-tipped pilose hairs inside the upper half of the tube, 2-lipped, the upper-lip 2-lobed, the lower 3-lobed; lobes subequal, rounded, 1-3 mm long, 2-3 (-5) mm wide; tube cylindrical, slightly curved, 7-11 mm long, c. 1 mm diam. *Stamens* inserted in corolla-throat, included; filaments puberulous, c. 1 mm long; anthers pale-yellow, 0.5-1 mm long, lobes divergent; staminodes filiform, puberulous, c. 1 mm long. *Ovary* oblong, glabrous, 1-2 mm long, 0.5-1 mm diam.; style included, filiform, glabrous, 6-9 mm long; stigma capitate. *Fruit* oblong, glabrous, 3-5 (-7) mm long, 1.5-2 mm across, striate and pustulate, dark purplish- to blackish-brown.

Representative specimens (collections seen: Australian 90, non-Australian 30)

AUSTRALIA: QUEENSLAND *Batianoff 1303 & McDonald s.n.*, between Half Moon Creek and Earl Hill near Cairns, 6.x.1979 (BRI); *Blake 19901*, The Gap, 17.iii.1956 (BRI, K, L); *Blake 23537*, Cooktown, 24.x.1970 (BRI,

K, L); *Boyland & Gillieatt 375*, c. 22.52km N of Mossman, 15.xi.1969 (BRI, GH, L); *Clarkson 3823*, Thursday Island, 18.x.1981 (BRI, K, QRS); *Coveny 6920*, 9.2km SW Cannonvale on Proserpine-Shute Harbour road, 3.ix.1975 (BRI, K, L); *Everist 5121*, Port Douglas, 20.v.1952 (BRI, CANB, K, NY); *Everist s.n.*, near Townsville, 17.x.1958 (BRI, CANB, K, NY); *Flecker 8074*, Collins Av. Edge Hill, Cairns, 1.v.1943 (NSW 231737, NY 3711 p.p.); *Halliday 355*, 8km N Rockhampton, 5.iv.1975 (BRI, HO); *McDonald 3274*, Bulburin State Forest, just W of junction of Pine and Granite Creeks, 17.iv.1980 (BRI); *Michael 707*, Proserpine, undated (BM, GH); *Morton 708*, Weipa, 13.iii.1980 (MEL); *Phillips s.n.*, Bowen, 29.ix.1970 (BRI 141638, CBG 041757); *Powell SP30*, 1.6km W Bamaga, 30.vi.1973 (CBG); *Sharpe & Batianoff 3874*, Noosa National Park, Noosa, 50 m SW of Boiling Pot, 6.ix.1985 (BRI, MEL); *Skerman s.n.*, Iron Range Mission, -viii.1955 (JCT S-2429); *Smith 12457*, West of Bamaga, c. 2.7km SW of Cape York, 26.x.1965 (BRI, GH, L); *Stanley 507*, N Rockhampton, 18.ii.1980 (BRI); *Stanley 897*, Bundaberg, near city centre, 17.iii.1980 (BRI); *Stoddart 4084*, Bewick Island, 29.vii.1973 (BRI, K, L); *Wannan & Quinn UNSW 20357*, hilltop above southern end of Conway Beach, 11.x.1988 (BRI, UNSW); *White s.n.*, Enoggera, 17.iii.1912 (BRI 274754, NSW 231746); *Wollaston & Hindmarsh s.n.*, Horn Island, 17.xi.1966 (JCT).

NORTHERN TERRITORY: *Rankin 2515*, Sadgrove Creek area, Winnellie, Darwin, 4.vii.1980 (BRI, DNA); *Russell-Smith & Lucas 2883*, Groote Eylandt, Angurugu, 22.vii.1987 (DNA); *Specht 924*, Melville Bay, Arnhem Land Aboriginal Reserve, 17.viii.1948 (AD, BRI, CANB, DNA, GH, K, L, MEL, PERTH); *Weber 10125*, c. 1km from Stuart Highway on road to Batchelor at creek crossing, 11.vi.1988 (AD, BRI, CANB, CBG, DNA, MEL, NSW, PERTH).

COCOS (KEELING) ISLANDS: *George 16235*, West Island (Pulo Panjang), 28.iv.1983 (AD, CBG, K).

PAPUA NEW GUINEA: *Benjamin MB1A*, University Port Moresby, 26.x.1974 (L).

INDONESIA: *Hiepko & Schultze-Motel 502*, Jayapura, West Irian, 29.i.1976 (B, L); *Hallier 267*, Java, Buitenzorg, 8.iii.1893 (BO, L); *Bünnemeyer 3251*, Sumatra, Mangani, 24.vi.1918 (BO, L).

NEW CALEDONIA: *Franc 2229*, Naumia, -1926 (L, P).

PHOENIX ISLANDS: *Fosberg & Stoddart 54895*, Canton Island, Central Pacific, 10.vi.1973 (L, US).

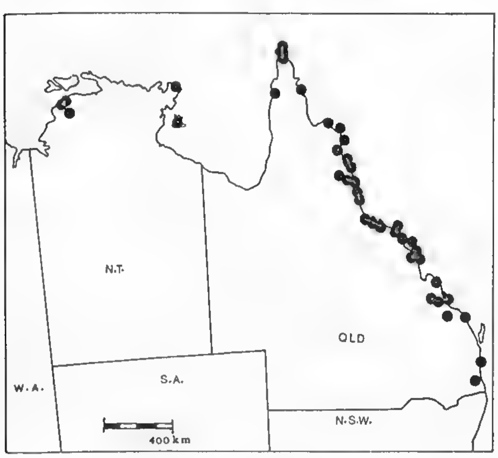
THAILAND: *Iwatsuki & Fukuoka T3487*, Payap, Chiangrai, interior of Ban Lang, 25.xii.1965 (BKF, KYO, L).

INDIA: *Bhargava 2837*, Long Island, Middle Andamans, 28.vii.1975 (L).

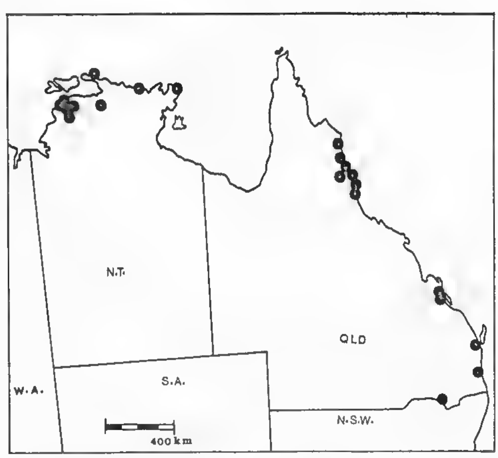
COSTA RICA: *Burger, Visconti & Gentry 10362*, Caribbean Coast between the Rio Bananito and Cahuita, Limon Province, 9-14.ii.1977 (AD, F).

CHINA: *Chow 78221*, Janfengling, Hainan, -1978 (AD, PE).

HAWAIIAN ISLANDS: *Herbst 6109*, Kapapa Islet, Oahu, 24.v.1978 (BISH).



Map 2. Distribution of *S. jamaicensis*



Map 3. Distribution of *S. cayennensis*

Distribution and ecology (Map 2)

S. jamaicensis is widely distributed throughout tropical and subtropical America (including West Indies) and introduced in parts of tropical Africa, Madagascar, the islands of Indian Ocean, tropical Asia, Australia and Oceania. In Australia, it is naturalised and chiefly distributed in the coastal areas of Northern Territory and Queensland. In Northern Territory, most localities are from Darwin southwards to the township of Batchelor along the Stuart Highway. Outside this area, one known locality is near Melville Bay and another on Groote Eylandt in the Gulf of Carpentaria.

Distribution in Queensland is mainly along the east coast. It has most commonly been recorded from the areas between Cooktown and Bundaberg. The northern-most locality on mainland Queensland is around Bamaga near the tip of Cape York Peninsula and the southern-most in the Brisbane area. On the Gulf-side, it has been recorded from the coastal area near Weipa. Besides, this species has been recorded from several off-shore islands in the Torres Strait and along the Great Barrier Reef.

According to collectors' field notes, *S. jamaicensis* in Australia is a common weed of disturbed soil on roadside, vacant land and waste places, especially in pastures and sandy thickets near the sea. The main habitat is alluvial, gravel-loam and sandy soils of grassland and beach ridge plain.

Comments

According to Moldenke (1983), this species "has been widely confused with *S. indica* (L.)M. Vahl and *S. urticaefolia* (Salisb.)Sims. It hybridises readily with the latter species when they grow in close proximity, as well as with other species in the genus." Accordingly Danser (1929) described the following hybrids between *S. jamaicensis* and other species of the genus: *S.* x*gracilis* Danser (*S. cayennensis* x *S. jamaicensis*), *S.* x*intercedens* Danser (*S. indica* x *S. jamaicensis*) and *S.* x*speciosa* Danser (*S. mutabilis* x *S. jamaicensis*). Urban & Ekman (1929), however, proposed the name *S.* x*adulterina* Urb. & Ekman for the hybrid between *S. mutabilis* and *S. jamaicensis*. Wagner et al. (1990) hold the view that "*S. jamaicensis* hybridises with *S. urticifolia* [*S.* x*intercedens* Danser]" and "in general the hybrids resemble *S. jamaicensis* more closely than *S. urticifolia*, but the corollas are darker in colour than typical in *S. jamaicensis*, the habit is more erect, and the leaves are usually more ovate, darker green, and with more divergent teeth similar to *S. urticifolia*". The above mentioned colour character in leaves and corolla seems less reliable as it often tends to fade in dry specimens. Moreover, as indicated above, the hybrid *S.* x*intercedens* Danser was evolved by the hybridisation of *S. indica* and *S. jamaicensis*, not between *S. urticifolia* and *S. jamaicensis*.

The field note on *Clarkson 6397* reads: "Only a single flower opens per spike at any one time".

Moldenke (1940a, 1940b, 1973, 1983) and Wagner et al. (1990), described the leaves as "alternate or opposite". However, the leaves as on all Australian and overseas specimens examined are found to be opposite.

The attenuate lamina is decurrent and is often not demarcated from the petiole. Where the petiole is not distinct, the leaf is considered to be subsessile. The petiole measurements, are only taken from those leaves where it is fairly distinct from the lamina.

Of all the specimens examined, the thickest (± 7 mm diam.) spike is noticed in a collection by *Burger, Visconti & Gentry 10362* from Costa Rica. The peduncles of terminal

spikes are often almost double the length of lateral ones.

According to Moldenke (1983), "the juice of the leaves, roots, or the entire plant is used in many countries as a tonic, emetic, expectorant, ... stimulant, ... purgative ... and cooling agent. It is used locally in various parts of its range in the treatment of headaches, earaches, malaria, tertian fever, yellow fever, ... syphilis, jaundice ... and wounds caused by blows, liver trouble ... intestinal worms, and nervous pains. It is widely used in the treatment of eye troubles such as cataracts and of sores in children's ears and the leaves in the treatment of heart troubles and as an adulterant in tea. In Java it is fed to horses and cattle as fodder. In Indonesia the stem-tips are eaten as a flavouring. ... In Malaya a decoction of the leaves is employed against ulcers in the nose and as an antiperiodic in cases of malaria. In Cuba the juice is used as a bath in treating skin diseases ... In Jamaica it is used to treat stomach-ache ... and ulcers ... In fact, writers assert that in Jamaica "It is very much in repute among the Indian and negro doctors for the cure of most diseases"."

Among its 100 or more popular names in various parts of the world are: "Blue Porterweed", "Blue snakeweed", "Jamaica vervain", "Verbena azul", "Jamaica false vervain", "Verbena manza", "Bastard-Vervain" and "Vervain".

Affinity

Amongst Australian *Stachytarpheta* species, *S. jamaicensis* seems closely related to *S. cayennensis* in its stems, leaves and inflorescence being glabrous. For differences and other similarities see "Key to the species" and "affinities" under the latter.

2. **Stachytarpheta cayennensis** (Rich.)M. Vahl, Enum. Pl. 1 (1804) 208 —"*S. cajanensis*"; E. Steudel, Nomenc. Bot. 2 (1841) 629 - "*S. cajanensis*"; Walp., Rep. Bot. Syst. 4 (1845) 5 - "*S. cajanensis*"; Schauer in A.DC., Prod. 11 (1847) 562; Briq. in Engler & Prantl, Pflanzenfam. 4, 3a (1895) 154; Hallier f., Meded. 'sRijks Herb. 37 (1918) 20; C. White, Qld Agric. J. N.Ser. 16 (1921) 195; Mold., Lilloa 4 (1939) 299; Danser, Ann. Jard. Bot. Buitenzorg 40 (1929) 2; F. Went, Ann. Jard. Bot. Buitenzorg 43 (1933) 1-2, fig. 1; Benth., Ann. Nat. Hist. 2 (1839) 447; Mold., Fl. Suriname 4 (1940) 274; Mold., Publ. Carnegie Inst. Wash. No. 522 (1940) 180; A.D.J. Meeuse, Blumea 5 (1942) 69; Brenan, Kew Bull. 1950 (1951) 223-225; Mold., Résumé Verbenac. etc. (1959) 468; J.F. Macbr., Fl. Peru 13 (1960) 658; Hepper, Fl. W. Trop. Afr. 2 (1963) 434, fig. 305 G-K; Backer & Bakh.f., Fl. Java 2 (1965) 598; Gooding et al., Fl. Barbados (1965) 363 p.p. excl. descr.; D.N. Gibson in Standley & L.O. Williams, Fl. Guatemala (1970) 225; Mold., Fifth Summary Verbenae. etc. 1 & 2 (1971) 907; Adams, Fl. Pl. Jamaica (1972) 632; H. St. John, List & Summary Fl. Pl. Hawaii Isl. (1973) 291; Mold., Ann. Missouri Bot. Gard. 60 (1973) 77; Al. Fed., Chromosome number Fl. Pl. (1974) 716; Mold., Phytologia 28 (1974) 462; Lopez-Pal., Fl. Venezuela Verbenac. (1977) 520, fig. 123; Mold., Fifth Summary Verbenac. etc. (1980) 341; Mold., Phytologia 50 (1982) 264; Stanley in Stanley & Ross, Fl. S.E. Qld. 2 (1986) 366; Dunlop, Checklist Vasc. Pl. N. Terr. (1987) 80; Jansen-Jacobs in A.R.A. Gorts-van Rijn, Fl. Guianas 4 (1988) 67, fig. 19; Howard, Fl. Lesser Antilles Part 3 (1989) 239.

Lectotype: *M. Leblond 356*, Cayenne, French Guyana, 1792 (G, lectotype designated here; K, P, n.v. isolectotypes).

Verbena cayennensis Rich., Actes Soc. Hist. Nat. Paris 1 (1792) 105, **basionym.**
Type: As for *Stachytarpheta cayennensis* (Rich.)M. Vahl.

S. dichotoma (Ruíz Lopez & Pavón)M. Vahl, Enum. Pl. 1 (1804) 207; Steudel, Nomen. Bot. 2 (1841) 629; W.F. Hillebrand, Fl. Hawaiian Isl. (1888) 341; Briq. in Engl. & Prantl, Pflanzenfam. 4, 3a (1895) 154; Bailey, Qld Fl. 4 (1901) 1172; Compr. Cat. Qld Pl. (1913) 382; Ewart & Davies, Fl. N.Terr. (1917) 236; H.J. Lam, Verbenac. Malay. Archip. (1919) 21; Bull. Jard. Bot. Buitenzorg, Sér. III, 3 (1921) 6; C. White, Qld Agric. J. 16 (1921) 194,

t. 38; Mold., Fl. Suriname 4 (1940) 272 excl. descr.; Webb, Bull. Council Sci. Industr. Res. No. 232 (1948) 169; Chippendale, Proc. Linn. Soc. N.S.W. 96 (1972) 256; Mold., Phytologia 28 (1974) 462; Al. Fed., Chromosome Numbers Fl. Pl. (1974) 714; Lopez-Pal., Fl. Venezuela Verbenac. (1977) 528, p.p. excl. syn. *S. australis* Mold.; Mold., Sixth Summary Verbenae etc. (1980) 317, 327, 332, 339, 341, 342; Mold. in Dassan. & Fosb., Fl. Ceylon 4 (1983) 261; Dunlop, Checklist Vasc. Pl. N.Terr. (1987) 80; Wagner et al., Man. Fl. Pl. Hawaii 2 (1990) 1321 excl. descr.
Type: *Dombey s.n.*, Cochero, Peru, undated (P, lectotype! designated here, MA 5 spec., isolectotypes!).

Verbena dichotoma Ruíz Lopez & Pavón, Fl. Peruv. Chil. 1 (1798) 23, t. 34.
Type: As for *Stachytarpheta dichotoma* (Ruíz Lopez & Pavón)M. Vahl.

S. urticaefolia (Salisb.)Sims, Bot. Mag. 43 (1816) t. 1848 - "*urticifolia*"; Mold., Résumé, Verbenac. etc. (1959) 199, 202, 204-207, 210, 212; Santapau, Rec. Bot. Surv. Ind. 16 (1960) 188; Fifth Summary Verbenac. etc. 1 (1971) 327, 331, 333, 334, 337, 340-342, 344, 348, 351-353, 473; Sixth Summary Verbenac. etc. Phyt. Mem. II (1980) 329, 330-334, 339, 341-344; in Dassan & Fosb., Fl. Ceylon 4 (1983) 257; Dunlop, Checklist Vasc. Pl. N.Terr. (1987) 80; Howard, Fl. Lesser Antilles 6 (1989) 240; Wagner et al., Man. Fl. Pl. Hawaii 2 (1990) 1322, t. 194.
Type: *Isaac Swainson s.n.*, collection from cultivated material near London in or before 1806 (BM, n.v.).

Cymburus urticaefolius Salisb., Parad. Lond. (1806) t. 53.
Type: As for *S. urticaefolia* (Salisb.)Sims.

S. hirta Kunth, Nov. Gen. & Sp. 2 (1817) 280; Walp., Repert. Bot. Syst. 4 (1845) 5.
Type: "Crescit in collibus aridis Regni Novo-Granatensis prope Olleros et Sondorillo, alt. 800-1000 hex", undated (?P, n.v.).

S. veronicaefolia Cham., Linnaea 7 (1832) 246; Walp., Repert. Bot. Syst. 4 (1845) 8; Steudel, Nom. Bot. 2 (1841) 629.
Type: E. Brasilia misit Sellowius, (?LE, n.v.).

S. guatemalensis Mold., Publ. Carnegie Inst. Wash. No. 522 (1940) 181; Ann. Missouri Bot. Gard. 60 (1973) 76.
Type: *Hans von Türckheim 11·1823*, at Coban, alta Verapaz, Guatemala, June 1907 (NY, holotype!).

S. guatemalensis Mold., f. *albiflora* Mold., Phytologia 9 (1963) 99.
Type: *Elias Contreras 1579*, in an airfield clearing at Dos Lagunas, El Petén, Guatemala, 3.xi.1960 (LL, n.v.).

S. tabascana Mold., Phytologia 1 (1940) 437.
Type: *Eizi Matuda 3218*, at Reforma, Balancan, Tabasco, Mexico, 22-26.v.1939 (NY, n.v.).

S. indica auct. non (L.)M. Vahl: sensu Cooke, Fl. Pres. Bombay, repr. edn 2 (1967) 501.

Lippia cylindrica Scheele, Linnaea 17 (1843) 246.
Type: "*Hartelbem 1832*, In provincia Minarum generalium, Brazil" (Present location unknown, probably in Herb. B and was destroyed during the war).

Valerianodes cayennense (Rich.)Kuntze, Rev. Gen. Pl. 2 (1891) 510; Brittan & P. Wilson, Sci. Surv. Puerto Rico & Virgin Isls 6 (1925) 143.
Type: As for *Stachytarpheta cayennensis* (Rich.,)M. Vahl.

Abena cayennensis (Rich.)Hitchc., Ann. Rep. Missouri Bot. Gard. 4 (1893) 117.
Type: As for *Verbena cayennensis* Rich., loc. cit.

Typification

S. cayennensis is based on *M. Leblond 366*, known from at least 3 specimens one each in Herb. G, K and P. Since the author of the basionym did not specify a holotype, a lectotype is selected here. Of the three syntypes, the one in Herb. P could not be found. Between the remaining two, the one in Herb. G has the collector's label indicating collector's name and his collection number, the locality name and the year of collection. Moreover, the basionym *Verbena cayennensis* is hand-written on the label and the specimens appear to have been used by the author in preparing the protologue of this species. The specimen seems to be a better representative of this taxon and is chosen here as the lectotype of this species.

The synonym *S. dichotoma* (Ruíz Lopez & Pavón)M. Vahl is based on Dombey's unnumbered collection from Peru comprising at least six duplicates. Five duplicates are

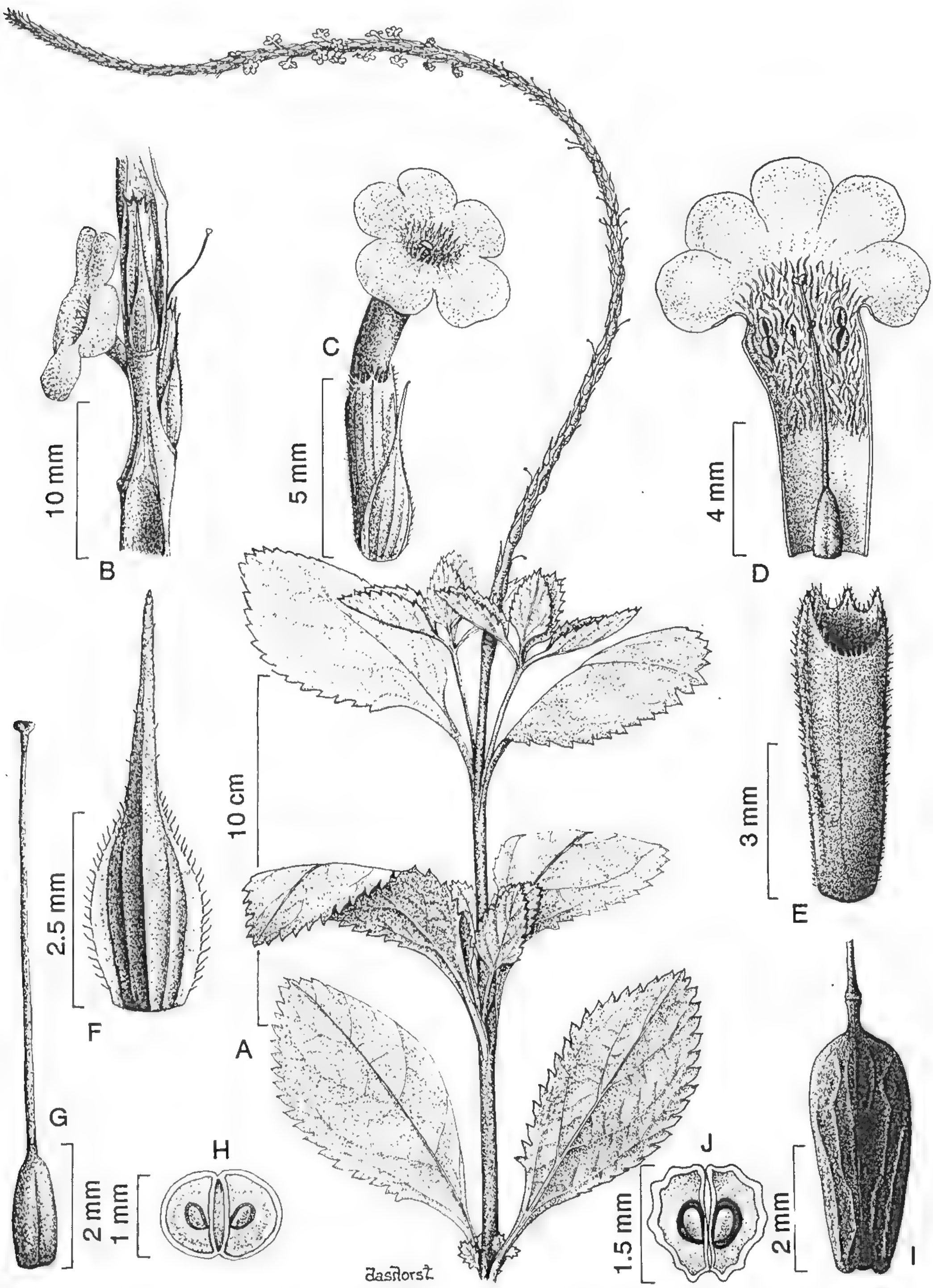


Fig. 3. *Stachytarpheta cayennensis* (Rich.)M. Vahl (A-J, *I. Cowie 204*: CANB). A, habit sketch of a flowering branch; B, part of rachis showing bracts, flowers and furrows; C, flower with bract; D, corolla vertically cut open showing androecium, gynoecium and hairy inside; E, calyx; F, flower-bract; G, gynoecium; H, transverse section of ovary; I, fruit; J, transverse section of fruit.

preserved in Herb. MA and one in Herb. P. Since the author of its basionym did not select a holotype, a lectotype is chosen here. Of all the syntypes, the one preserved in Herb. P seems to be a better representative of this taxon and is selected here as a lectotype.

Description (Fig. 1B & 3)

Herb or subshrub (0.5-) 1-2 (-2.5) m high. *Stem* dichotomously branched, subterete or weakly tetragonal; branches and branchlets glabrescent-puberulous, hairy on nodes, dark purplish-blue when alive. *Leaves* petiolate, bright green; lamina ovate-elliptic or oblong-elliptic, acute at the apex, long attenuate or decurrent into petiole, with crenate-serrate margin, (2-) 3-8 (-10) cm long, (1-) 2-4 (-5) cm wide, glabrous or sparsely strigose on veins below, membranous-chartaceous when dry; petiole glabrescent or puberulous-strigose (2-) 5-15 (-20) mm long. *Spikes* slender, flaccid, (10-) 15-40 (-45) cm long, subglabrous or puberulous; peduncle puberulous when young, almost glabrous when old, (5-) 10-20 (-30) mm long; rachis puberulous or subglabrous, 1-3 mm diameter, with the furrows from half immersed flowers as wide as the rachis; bracts ovate or ovate-subulate, subglabrous, 3-5 mm long, 1-2 mm wide near base, the margins scarious in the lower half, the upper subulate half with apices setaceous acuminate. *Flowers* sessile, spreading during anthesis. *Calyx* compressed, 4-costate, about equalling or surpassing the subtending bracts, 4-6 mm long, 1-2 mm diam., shortly puberulous or subglabrous outside, glabrous inside, the rim bifid with 4 equal teeth; teeth subulate, 0.5-1 mm long. *Corolla* pale blue to blue, pale violet, purple, violet or lavender, occasionally white, salver-shaped, glabrous outside, villous inside the upper half of the tube and throat; tube cylindrical, curved, longer than calyx, 6-7 mm long, 1-2 mm diam.; lobes subequal, with limb spreading to about 5 mm diam., rounded or very broadly ovate-orbicular, 1-4 mm long, 3-5 mm wide. *Stamens* included, inserted in corolla-throat; filaments 0.5-1 mm long, pubescent; anthers ± 1 mm long with divergent lobes; staminodes filiform, pubescent. *Ovary* oblong, glabrous, 1-2 mm long, c. 1 mm diam.; style included, filiform, glabrous, 4-7 mm long; stigma capitate. *Fruit* oblong, glabrous, somewhat compressed, 3-4 mm long, 1.5-2 mm wide, dark brown to blackish.

Representative specimens (collections seen: Australian 50, non-Australian 35).

AUSTRALIA: QUEENSLAND: *Batianoff 1138 & Donald s.n.*, S of Buchan Point and 0.5km W of Palm Cove near Cairns, 3.x.1979 (BRI); *Beauglehole 3288*, Tinana Creek, 8.vi.1955 (MEL); *Boyland 375 & Gillieatt s.n.*, c. 6.43km N of Mossman on roadside, 15.xi.1969 (BRI, K); *Brass 33491*, Kuranda, 7.viii.1966 (BRI, K, QRS); *Briggs 1972*, Barron Falls railway station, 16.09km NW of Cairns, 3.viii.1968 (NSW); *Clarkson 7265*, Kuranda, Myolla Road, 14.vii.1987 (AD, BRI, MBA, NSW, QRS); *Everist 5081*, 8.4km N Tully, 16.v.1952 (BRI, CANB, K, LAE); *Everist 5094*, 14.48km N Babinda, 17.v.1952 (BRI, CANB, K, LAE); *Everist 6038*, South Johnstone, 8km W of sugar mill, 9.x.1958 (BRI, CANB); *Everist 7962*, Barrets Lagoon, c. 24km SE Tully, 11.xii.1966 (BRI); *Everist 8109*, camping reserve, 25km ESE of Rockhampton, 4.x.1968 (BRI); *Everist s.n.*, Wellington Point, 1.vi.1980 (BRI); *Flecker 8093*, Collin Av., Edge Hill, 1.v.1943 (NSW 231737, NY 3711); *Hauser s.n.*, Redlands, 27.i.1983 (BRI); *Hyland 1804*, Smithfield R1073, 24.iii.1961 (BRI); *Johnson 3719A*, Pebbly Beach, on Cairns - Mossman Road, 15.vi.1977 (BRI, CANB); *Robinson s.n.*, 24km E Rockhampton, 22.xii.1974 (BRI); *White 11737*, Innisfail, 6.xii,1941 (BRI, GH, K).

NORTHERN TERRITORY: *Allen 449*, Darwin, -.ii.1920 (NSW); *Cowie 204*, East Jabiru, 20.x.1984 (DNA, CANB); *Dunlop s.n.*, Nightcliff, Darwin, 7.vii.1980 (BRI, DNA); *Fox 826*, East Point Reserve, 2.iv.1975 (AD); *Munir 6193*, Adelaide River Township, 12.vi.1988 (AD, BRI, CANB, DNA); *Must 1367*, Kemp Airstrip, 14.iv.1977 (CBG, DNA); *Pickering s.n.*, Meneling, 24.ii.1987 (DNA); *Rankin 2686*, Rum Jungle, 7.iv.1983 (DNA); *Russell-Smith 3635 & Lucas s.n.*, Croker Island, Baniwurnldalk, 7.x.1987 (DNA); *Turely 58*, Middle Pt. Village, Coastal Plains, 18.v.1989 (DNA); *Waldeck s.n.*, Fogg Dam Area, 9.vii.1980 (BRI, DNA); *Wightman 4274*, Nhulunbuy, NE Arnhem Land, 21.ii.1988 (DNA); *Wightman 4401*, Milingimbi, Arnhem Land, 15.iv.1988 (DNA).

WESTERN AUSTRALIA: *Mead s.n.*, Cockatoo Island, 11.vii.1967 (PERTH).

CHRISTMAS ISLAND: *Mitchell 35*, Cemetery Road, North East Point, 12.vi.1984 (AD, CBG, K); *Stokes 18*, Dales Track, 14.viii.1983 (CBG).

PAPUA NEW GUINEA: WEST NEW BRITAIN: *Barker & Vinas LAE 66732*, seashore at Wongonokai Village,

subdistrict Talasea, 27.x.1974 (AD, BISH, BRI, E, GH, K, L, LAE, M, NSW, QRS, US); *Sohmer et al. LAE 75326*, rainforest on ridges of left bank of Kapiura River, c. 3km up stream from the confluence of the Aum River, Hoskins subprov., 17.v.1979 (BRI, CANB, CBG, L, LAE, UPNG).

HAWAII: *Degener 21483*, Kauai, Hanabi Valley, 29.xii.1951 (BISH).

CHINA: *Chow & Wan 80167*, Yunnan Prov., Xishuanbanna, alt 700 m on slopes, -1980 (AD, PE).

FRENCH GUIANA: *Leblond 356*, Cayenne, 1792 (G!, K!, P, syntypes of *S. cayennensis* (Rich.)M. Vahl).

PERU: *Dombey s.n.*, Cochero, undated (MA!, P!, syntypes of *S. dichotoma* (Ruíz Lopez & Pavón)M. Vahl).

Distribution and ecology (Map 3)

S. cayennensis is a native of tropical America now widely introduced into other parts of the tropics. In Australia, it is known to occur chiefly in the coastal regions of Northern Territory and Queensland. In the Northern Territory, the distribution is restricted to the botanical province "Darwin and Gulf Region" where most localities are around Darwin and southwards in Rum Jungle and Adelaide River township area. It has also been recorded from Jabiru in Kakadu National Park. Along the northern coast, it is reported to occur on Croker Island and around the townships of Milingimbi and Nhulunbuy.

Distribution in Queensland is mainly in the coastal area of Atherton Tableland between Cooktown and Ingham. Elsewhere, it has been recorded from near Rockhampton, Maryborough and Brisbane. Within this State, the southern-most locality is at Smithfield near the New South Wales border. So far, this species has not been recorded from the northern half of Cape York Peninsula, any off-shore island of this state or from the Gulf of Carpentaria.

Only one "horticultural" collection is known from Western Australia where it is said to be "used as a hedge". It is likely that it will be found naturalised in the Kimberley region.

Collections from overseas have been seen from Christmas Island, Papua New Guinea, Hawaiian Islands, China, French Guiana and Peru. According to Moldenke (1973), "the species is widely distributed throughout tropical and subtropical America from Alabama through the West Indies, Mexico, and Central America to Ecuador and Brazil; introduced in parts of tropical Africa, Madagascar, the islands of the Indian Ocean, tropical Asia, Australasia, and Oceania".

In Australia, collectors have recorded this species from a variety of habitats. Generally, it grows in disturbed roadside clearings, old mined land, as a weed in wasteland and horse paddocks. It has been recorded from monsoon forest edge, base of inland seacliffs, secondary rainforest, beach ridge plains, *Melaleuca* open forest, edge of water and on fringes of open forest with dense understorey among pasture grasses. The collections examined came from one of the following soil types namely "clay loam", "red loam", "stony red clay loam", "sandy plain", "swamps", "grey loam" and "black soil plain". In Queensland, *S. cayennensis* is said to grow "strongly around Kuranda and beating *Lantana* in growth in some places". According to Adams (1972), this species is common in Jamaica, especially in rough pastures and damp waste places". In Guatemala, Gibson (1970) recorded it from "Damp thickets, forest, or swamps, sometimes in pine forest, often a weed in waste places, sea level to 1,500 meters".

Comments

Brenan (1950) attributed the combination of this species to Schauer (1847) instead of M. Vahl (1804). In his opinion: "Richard's original spelling of the epithet, '*cayennensis*', must

be retained. My colleague Mr R. Milne-Redhead has kindly pointed out that M. Vahl, to whom the combination under *Stachytarpheta* is usually attributed, spelt the epithet '*cajanensis*' — a version so different from the original as in effect to constitute a new name, and a quite unjustified one. Link's later 'compromise' — '*cayanensis*' — does not affect the problem. The binomial *Stachytarpheta cayannensis* is therefore here attributed to Schauer, who was the first to transfer Richard's epithet to *Stachytarpheta*". The above opinion was accepted by Hepper (1963), but the majority of botanists have attributed the combination to M. Vahl (1804). Vahl's spelling of the epithet "*cajanensis*" is considered only an orthographic error which was corrected by Schauer (1847) and subsequently accepted by the majority of botanists. The orthographic error in the specific epithet is somewhat similar to the orthographic error made by Link (1821) in the generic name from *Stachytarpheta* to *Starchytarpha*, which was accepted by Schauer (1847). However, this orthographic error has not been accepted by Brenan (1950) himself because in his opinion it "cannot be upheld under the rules" and, therefore, accepted the corrected version without alteration of the authority. Similarly, the orthographic error in the specific epithet by M. Vahl (1804) has been corrected by Schauer (1847) but the combination under *Stachytarpheta* should be attributed to M. Vahl (1804) who was the first to transfer it from *Verbena* to *Stachytarpheta*.

Bailey (1901) recorded *S. mutabilis* and *S. dichotoma* from Queensland. In 1940, Moldenke regarded *S. cayennensis* and *S. dichotoma* as distinct species and included *S. urticaefolia* in the synonymy of *S. dichotoma*. Subsequently, Moldenke (1973) recognised *S. cayennensis* and *S. dichotoma* as conspecific and placed *S. dichotoma* in the synonymy of *S. cayennensis*. In Flora of Ceylon, however, Moldenke (1983) reinstated *S. urticaefolia* as a distinct species. During the present investigation, a range of material identified as *S. cayennensis* and *S. dichotoma* has been examined and found to belong to the same taxon. The types of these two taxa have also been examined and are found to be conspecific. The type of *S. urticaefolia*, based on cultivated material from near London, was probably not kept. However, if it was preserved in the British Museum (Natural History), it has not been found there by the present author, or by the herbarium staff at the BM. All material in the British Museum (Natural History) and at Kew, identified as *S. urticaefolia*, seems to match well with *S. cayennensis* and *S. dichotoma*. In the present treatment, therefore, *S. cayennensis*, *S. dichotoma* and *S. urticaefolia* are treated as conspecific. Of these three, the binomial *S. cayennensis* being based on the oldest valid name is retained and the other two names are placed in synonymy.

In some herbaria, the names *S. cayennensis* and *S. urticaefolia* have been erroneously used for the pubescent specimens of *S. frantzii* Palak. Similarly, material of *S. cayennensis* has been distributed in some herbaria as *S. dichotoma*, *S. indica*, *S. jamaicensis* and *S. urticaefolia*. According to Moldenke (1974), material of *Bouchea prismatica* (L.)Kuntze has sometimes been misidentified as *S. cayennensis*. The genus *Bouchea*, however, is not known to occur wild in Australia.

Rosette B. Fernandes (1984) typified a few *Stachytarpheta* species with somewhat elaborate notes on the typification of *S. jamaicensis*. However, she did not typify *S. cayennensis* though she saw and annotated its type in Herb. G during 1984. In the present treatment, therefore, this species has been lectotypified.

In his "Illustrated notes on the weeds of Queensland", White (1921) described this species under the name "SNAKE WEED (*Stachytarpheta dichotoma*)" but the illustration accompanying it is of *S. urticaefolia* previously published in Curtis's Botanical Magazine (1816) Plate 1848. A clear reference to the source of illustration has been given by White (1921) who seems to have treated these taxa as synonyms.

S. cayennensis is reported to hybridise with a few other species within the genus.

Accordingly, Danser (1929) described the following three hybrids: *S.* x*debilis* Danser (*S. cayennensis* x *S. indica*), *S.* x*gracilis* Danser (*S. cayennensis* x *S. jamaicensis*) and *S.* x*abortiva* Danser (*S. cayennensis* x *S. mutabilis*). Wagner et al. (1990) recorded *S. dichotoma* and *S. urticaefolia* as distinct taxa and noted their following hybrids: *S.* x*gracilis* (*S. dichotoma* x *S. jamaicensis*) and *S.* x*intercedens* Danser (*S. urticaefolia* x *S. jamaicensis*). It may be of interest to note that the original hybrid *S.* x*intercedens*, described by Danser (1929), was the result of the cross between *S. indica* and *S. jamaicensis*. As noted earlier in the synonymy, *S. dichotoma* and *S. urticaefolia* are now regarded here as synonyms of *S. cayennensis*, therefore, the above noted hybrid record by Wagner et al. (1990) is in fact applicable to *S. cayennensis*.

In Australia, *S. cayennensis* is known by the popular names "Bluetop" or "Snake Weed", an illusion to the long narrow blue spikes. Elsewhere, it is known by common names "Rat-tail", "Blue Snake-Weed", "Dark Blue Snake-Weed", "Snake-Weed" and by many other regional or local names. J.C. Loudon in his "Encyclopaedia of Plants" gives "Bastard Vervain" as a common English name. According to D.N. Gibson (1970) the species is called "Mozote" in Hondurus and "Wild Verbena" and "Camacolal" in British Hondurus.

Normally, the rim of each calyx has 4 teeth but in Robinson's (s.n.) collection from Rockhampton, some calyces are found to be 5- or 6-toothed.

Chromosome number in *S. dichotoma* has been reported by Wagner et al. (1990) as "[2n = 18, ca 112]".

Affinities

S. cayennensis is apparently close to *S. australis* in its leaves being more or less similar in shape, membranous, with sharply toothed margins; inflorescence slender and flexuose; rachis up to 3 mm diam. and flowers more or less similar in shape, size and colour. Nevertheless, *S. cayennensis* may easily be distinguished by its stem, leaves and inflorescence being glabrous or very minutely puberulous-glabrate; bracts ovate or ovate-subulate, glabrous, 1-2 mm wide. The stems, leaves and inflorescence in *S. australis* are pubescent; bracts linear-lanceolate, pubescent abaxially and 0.5-0.8 (-1) mm wide. *S. cayennensis* is also near to *S. jamaicensis* in its stems, leaves and inflorescence being glabrous. The latter, however, may readily be identified by its rachis being stout and firm, (2-) 3-5 (-7) mm diam.; furrows from half-immersed flowers narrower than the rachis; leaves somewhat fleshy; bracts larger, 4-8 x 1.5-2.5 mm. Moreover, in comparison to *S. jamaicensis*, the leaves in *S. cayennensis* are sharp toothed and with very sparse short hairs on the veins below, inflorescence subglabrate, bracts with scarious margins in the lower halves only and subulate in the upper halves, hairs inside the corolla-throat not gland-tipped and flowers not completely immersed inside the rachis.

3. **Stachytarpheta mutabilis** (Jacq.)M. Vahl, Enum. Pl. 1 (1804) 208; Sims, Curtis's Bot. Mag. 25 (1807) t. 976; Sprengel, Syst. Veg. 1 (1825) 53; Steudel, Nomenc. Bot. 2 (1841) 629; Walp., Repert. Bot. Syst. 4 (1845) 7; Schauer in A.DC., Prod. 11 (1847) 565; Miq., Fl. Ind. Bat. 2 (1856) 907; Griseb., Fl. Brit. W. Ind. Isls (1864) 494; Briq. in Engl. & Prantl, Nat. Pflanzenfam. 4, 3a (1895) 154; Trimen, Handb. Fl. Ceylon 3 (1895) 349; Baker in Dyer, Fl. Trop. Afr. 5 (1900) 284; Bailey, Qld Fl. 4 (1901) 1172; Gamble in King & Gamble, J. As. Soc. Beng. 74 (1908) 799; Bailey, Compr. Cat. Qld Pl. (1913) 282; H.J. Lam, Verbenac. Malay. Archip. (1919) 20; Bull. Jard. Bot. Buitenzorg, Sér III, 3 (1921) 6; Ridley, Fl. Mal. Penin. 2 (1923) 613; Danser, Ann. Jard. Bot. Buitenzorg 40 (1929) 10; Mold., Lilloa 4 (1939) 301; Mold. in Humbert, Fl. Madagascar (1956) 25; Gamble, Fl. Pres. Madras, repr. edn (1957) 763; Mold., Résumé Verbenac. etc. (1959) 191, 195, 199, 202, 207, 210, 277, 344, 346-349, 356, 370, 394, 469; Haines, Bot. Bihar & Orissa reprint edn 2

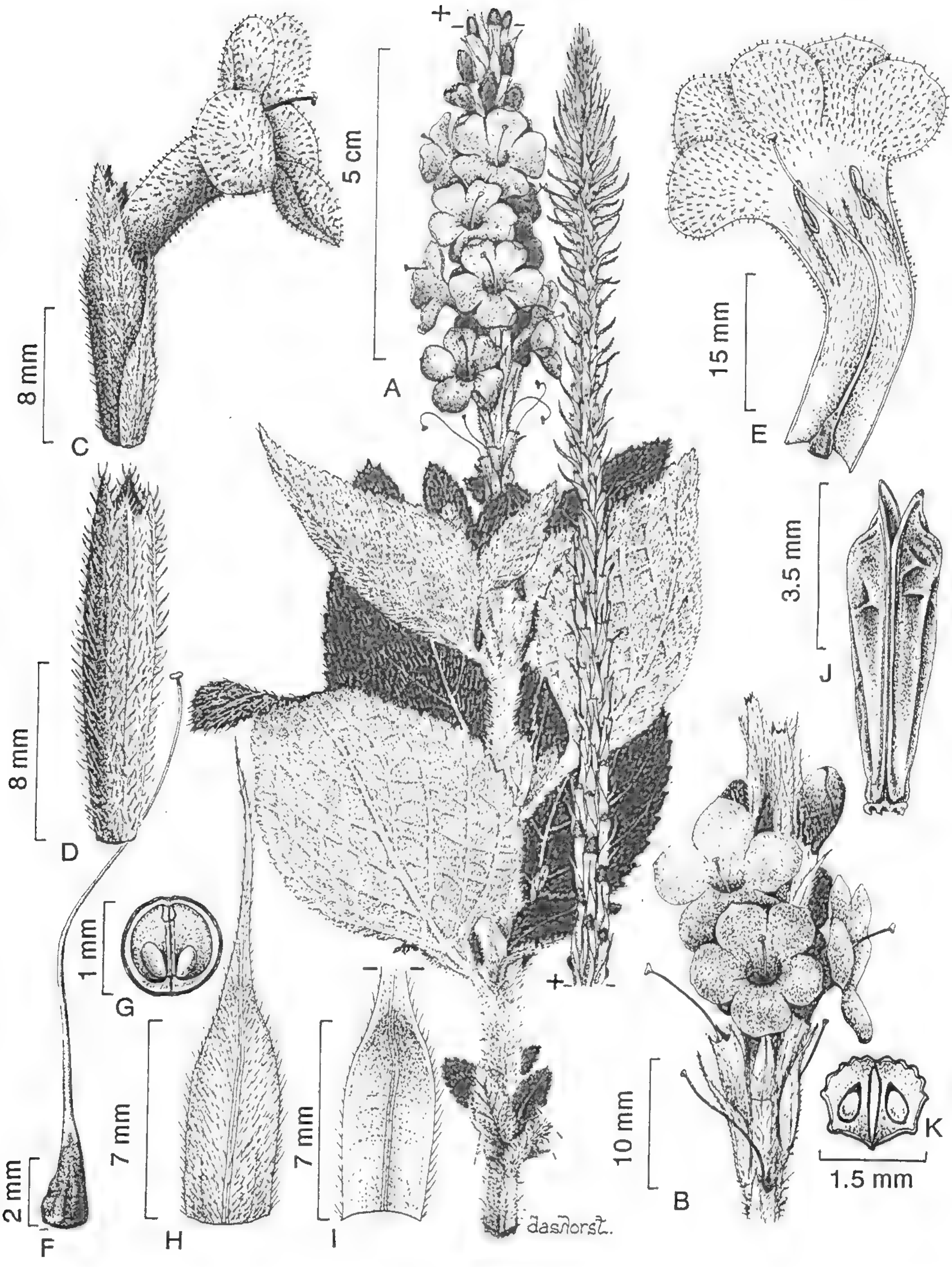


Fig. 4. *Stachytarpheta mutabilis* (Jacq.)M. Vahl (A-K, *J.R. Clarkson 7262*: AD). A, habit drawing of a flowering branch; B, portion of spike; C, flower with bract; D, calyx; E, corolla vertically cut open showing androecium, gynoecium and hairs inside the corolla-tube; F, gynoecium; G, transverse section of ovary; H, bract showing abaxial view; I, bract showing adaxial view; J, fruit; K, transverse section of fruit.

(1961) 741; Nair & Rehman, Bull. Nat. Bot. Gard. Lucknow 76 (1962) 11; Backer & Bakh.f., Fl. Java 2 (1965) 598; Gunawar., Gen. Sp. Pl. Zeyl. (1968) 146; Mold., Fifth Summary Verbenac. etc. 1 & 2 (1971) 327, 333, 337, 344, 348, 351, 368, 473, 632, 646-648, 684, 737; Adams, Fl. Pl. Jamaica (1972) 631; Lopez-Pal., Revista Fac. Farm. Univ. Los Andes-Merida No. 15 (1974) 84, fig. 16; Fl. Venezuela Verbenac. (1977) 537, fig. 126; Mold., Sixth Summary Verbenac. etc. Phytologia Mem. II (1980) 269, 297, 318, 323, 327, 333, 339, 341, 396, 439-441, 446, 462; Lord & J.H. Willis, Shrubs & Trees Aust. Gard, rev. 5th edn (1982) 264; Mold. in Dassan & Fosb., Fl. Ceylon 4 (1983) 248; Ros. Fernandes, Bot. Soc. Brot. Sér. 2, 57 (1984) 103; Stanley in Stanley & Ross, Fl. S.E. Qld 2 (1986) 366; Jansen-Jacobs, Fl. Guianas part 4 (1988) 71; Wagner et al., Man. Fl. Pl. Hawaii 2 (1990) 1322.

Lectotype: *Jacquin s.n.*, from a plant cultivated in the Hortus Schönbrunnensis, originally from the West Indies, undated (W, lectotype designated here!; BM, isolectotype!).

Verbena mutabilis Jacq., [Icon. Pl. Rar. 2 (1786) t. 207, nom. inval.], Collectanea 2 (1789) 334; Willd., Sp. Pl. 1 (1797) 115; Vent., Jard. Malmaison (1804) t. 36; Andrews, Bot. Repos. 7 (1806) t. 435.

Type: As for *Stachytarpheta mutabilis* (Jacq.)M. Vahl.

Zapania mutabilis (Jacq.)Lam., Tab. Encycl. Meth. Bot. (1791) 59.
Type: As for *Stachytarpheta mutabilis* (Jacq.)M. Vahl.

Cymburus mutabilis (Jacq.)Salisb., Parad. Lond. 1 (1805) t. 49.
Type: As for *Stachytarpheta mutabilis* (Jacq.)M. Vahl.

Stachytarpheta zuccagni Roemer & Schultes, Syst. Veg. edn 15, 1 (1817) 205.
Type: non designatus.

S. elegans Welw., Apont. Phytogeogr. Angola (1858) 588.
Type: n.v.

Valerianodes mutabilis (Jacq.)Kuntze, Rev. Gen. Pl. 2 (1891) 510.
Type: As for *Stachytarpheta mutabilis* (Jacq.)M. Vahl.

Stachytarpheta cayennensis (Rich.)Vahl var. *schiedeana* Loes., Bot. Jahrb. Syst. 23 (1896) 119 & 129.
Type: n.v.

S. variabilis Saunders, Floral Morphol. 2 (1939) 446.
Type: n.v.

Typification

The type of *Verbena mutabilis* was collected by Jacquin from a plant "growing in the hot house" at Hortus Schönbrunnensis near Vienna. It originally came from the West Indies where it is believed to be native. No known collection made directly from the West Indies was involved in preparing the protologue of this species. The type collection from the cultivated plant comprises at least two specimens one each in Herb. BM and Herb. W. Both specimens are in good condition and are annotated by the author.

Of the two syntypes, there was no type designated by the author nor any lectotypification made subsequently. Of the two syntypes, the one in Herb. W seems to be a better representative of this taxon and is, therefore, chosen here as the lectotype of this species.

Description (Fig. 1C & 4)

Shrub (1-) 2-4 (-5) m tall. *Stem* dichotomously branched, tetragonal, densely tomentose or villous throughout; branches ascending and leafy. *Leaves* petiolate; lamina ovate, ovate-elliptic or oblong-elliptic, cuneate and long-decurrent on petiole, acute or acuminate at apex,

crenate or serrate along margin from just above the base to the apex, (4-) 5-12 (-14) cm long, (2.5-) 3-6 (-8) cm wide, thick and leathery or membranous-chartaceous, often rugose, sparsely villous to scaberulous above, densely canescent-tomentose or villous-velutinous beneath, primary and secondary veins flat above, prominent beneath; petiole canescent-tomentose, (5-) 10-25 (-30) mm long. *Spikes* stout, terete, erect, (15-) 20-40 (-60) cm long, 6-8 (-10) mm diam. without open flowers, densely strigose-tomentose or hirtellous, the furrows shallow; peduncles pubescent-tomentose, (5-) 10-30 (-40) mm long; rachis pubescent-tomentose, 3-4 mm diam.; bracts divergent, narrowly ovate-elliptic, lanceolate or oblong-lanceolate, setaceous or somewhat subulate, acuminate, 8-12 mm long, 2-3 mm wide in the lower half, pubescent-hirsute abaxially, glabrous adaxially, ciliate along the margins, membranous, rigid, striate, the awn-like acumination often divergent or reflexed. *Flowers* sessile, half-immersed in the rachis-furrows. *Calyx* somewhat compressed, subequalling or more often longer than the subtending bract, recurved during anthesis, later completely immersed in the rachis-furrows, 8-14 mm long, 2-3 mm diam., pubescent-hirsute outside, glabrous inside, shortly 2-lobed at the apex with 4 unequal minute teeth of c. 0.5-1 mm long. *Corolla* red, purple-violet, scarlet, reddish-pink, blue-red or fading to pink, large, showy, hypocrateriform with minute and sparse glandular hairs on lobes and outside the tube, villous inside the upper half of the tube and throat; tube curved, cylindrical, dilated at the throat, much longer than the calyx, (13-) 15-20 (-25) mm long, 1.5-3 mm diam.; lobes subequal, spreading to about 13 mm diam., rounded, 3-6 mm long, (3-) 5-8 mm wide. *Stamens* inserted in corolla-throat, included; filaments filiform, pubescent, 2-3 mm long; anther-lobes completely divergent, slightly unequal, 1-2 mm long; staminodes filiform, pubescent, 2-3 mm long. *Ovary* ovoid-elliptic to oblong-elliptic, glabrous, 1.5-2 (-2.5) mm long, 1-1.5 mm diam.; style almost included or slightly exserted above the corolla-tube, filiform, glabrous, 13-16 mm long; stigma capitate. *Fruit* elliptic-oblong, subcylindrical but somewhat compressed, glabrous, shorter than the calyx, 5-7 mm long, 1.5-2 mm wide, somewhat striate and pustulate.

Representative specimens (collections seen Australian 21, non-Australian 30)

AUSTRALIA: QUEENSLAND: *Beauglehole 3327*, Port Douglas, 16.vi.1955 (MEL); *Blake 13316*, Mackay, 19.iii.1938 (BRI, CANB, MO); *Brass 33493*, Kuranda, 7.viii.1966 (BRI, QRS 3 spec.); *Clarkson 5099*, Mareeba, 22.xii.1983 (AD, BRI, K, MO, PERTH, QRS); *Clarkson 7262*, Kuranda, Myolla Road, 14.vii.1987 (AD, BRI, MBA, QRS); *Shire Clerk s.n.*, Cardwell, 9.iii.1921 (BRI); *Everist 5074*, 3.2km N of Cardwell, 16.v.1952 (BRI, CANB 2 spec., LAE); *Everist 5122*, Port Douglas, 20.v.1952 (BRI, CANB 2 spec., LAE); *Flecker 1983*, Double Island Road, Smithfield, 5.vii.1936 (QRS); *Gittons 572*, Ayton, -.vi.1962 (BRI, NSW 2 spec.); *Hatfield s.n.*, Roseville via Cooktown, 20.iv.1956 (BRI); *Hopkinson s.n.*, Chewko Road, Mareeba, 14.iv.1973 (QRS); *Hopkinson 3C*, Myola, 8.iii.1973 (QRS); *Hunt s.n.*, Kuranda, -.xi.1939 (BRI); *Johnson 3730*, Mareeba-Atherton Road, 12km S Mareeba, 16.vi.1977 (BRI); *Lahey s.n.*, Cairns, -.ix.1924 (BRI); *Persieh s.n.*, Endeavour River, -1887 (MEL 583733); *Stanley 419*, North Mackay, Roadcutting, 17.ii.1980 (BRI); *Stanley 1065*, Southern Bundaberg, 18.iii.1980 (BRI); *Stephens 11724*, Smithfield, 18.x.1947 (QRS); *Storr* [*F.A. Rodway No. 15044*], Cooktown, -.i-ii.1949 (NSW).

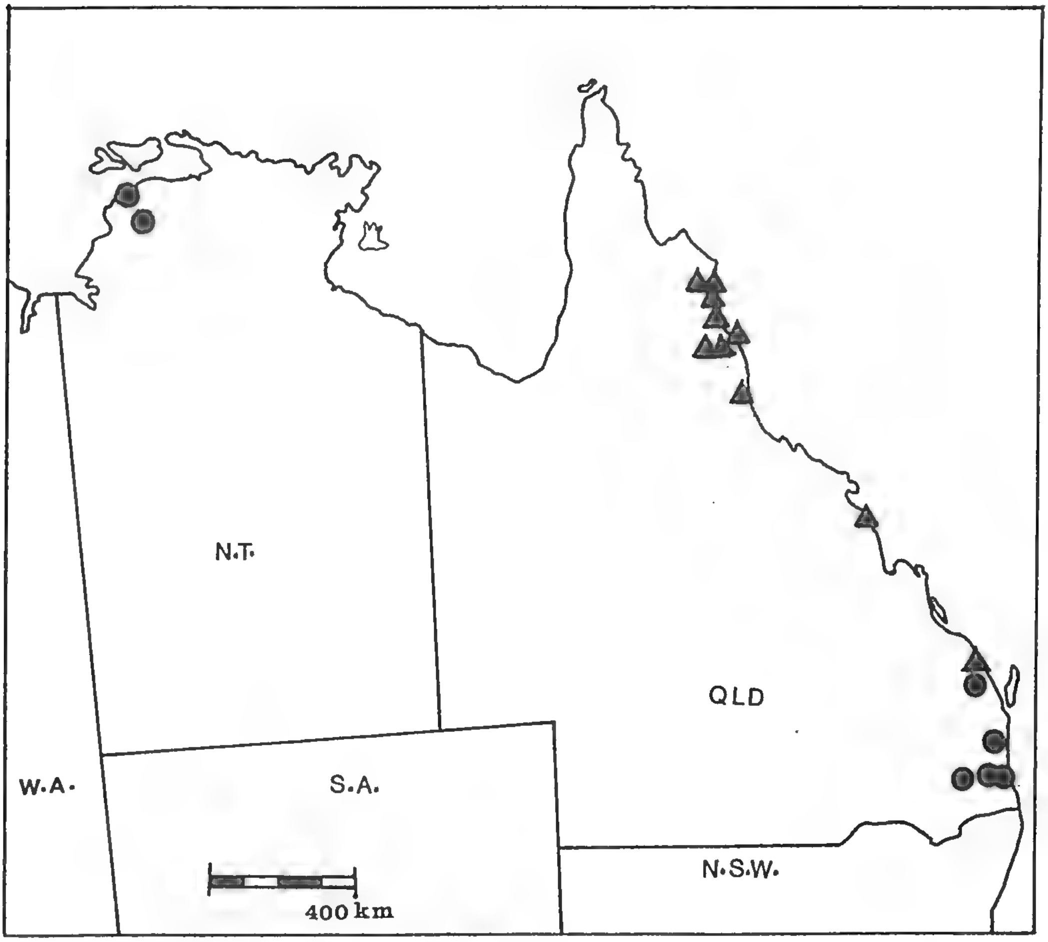
PAPUA NEW GUINEA: *Streimann & Kairo NGF 30753*, Junction Magere & Sogeri Roads, Central District, 15.viii.1967 (A, BISH, BO, BRI, BUL, CANB, K, L, LAE, SING); *Gebo UPNG 307*, Sogeri, Corner of Hombrum Bluff Road, Sogeri Subdistict, Central District, 28.iii.1970 (B, BUL, L, LAE); *Benjamin & Wiakabu LAE 67846*, Itikunumu Estate, Subdistrict Moresby, 25.v.1977 (A, BRI, CANB, E, K, L, LAE, M).

INDONESIA: *Osberger 402*, Sumatra, West Coast, -.viii.1953 (A, BRI, BISH, CAL, K, L, BM, LE, NY, P, PNH, SING). *Koorders 19539*, Celebes, 1914 (BO, L); *Seorten 716*, Java, 1.vii.1922 (BO, L).

MALAYSIA: *J. Carrick 1546*, Penang Hill, 18.i.1967 (K, L, SING).

HAWAIIAN ISLANDS: *Herbst 5300*, Kauai, in pasture at Hanalei end of the Pole Line Trail, 15.v.1975 (BISH); *Forbes 459*, roadside between Honabi and Rilawa, -.ix.1913 (BISH, L).

VENEZUELA: *Schomburgk s.n.*, Caracas, undated (AD).



Map 4. Distribution of *S. mutabilis* ▲, *S. australis* ●

Distribution and ecology (Map 4)

S. mutabilis is a native of South America naturalised in Australia in the tropical areas of north-eastern Queensland. The main distribution is on the coastal area between Cardwell and Cooktown, particularly along the eastern part of Atherton Tableland. Outside this area, it has been recorded only from near the township of Mackay and Bundaberg.

According to Moldenke (1983), "this species is rather widespread in the American tropics from Mexico and Cuba, through Central America and the West Indies, to northern South America and Central Brazil. It has been introduced in Angola, Madagascar, Mauritius, Réunion, India, Pahang, the Lingga Archipelago, Java, Amboina, Fiji and elsewhere. It is widely cultivated in Europe (since 1801), America, and Australia".

Collectors in Australia have found this species growing along "roadside in disturbed soil", "in weedy horse paddock" and "occasionally in *Lantana* thickets on formerly rain forested

slopes". According to Lord and J.H. Willis (1982), this species is "fast growing on warmer east coast in sheltered location". In Jamaica, it is "generally dispersed on banks, pathsides and in open areas in hilly districts" (Adams, 1972).

Comments

Moldenke (1983) states that this species is often employed to make fences and hedges in the American tropics. Lord (1964) asserts that it was originally imported to Australia to serve as an adulterant to tea. According to Wagner et al. (1990), "*Stachytarpheta mutabilis* hybridises with *S. urticifolia* [*S. xtrimenii* Rech.]. The hybrids are very similar to *S. mutabilis* but are usually lower in habit with smaller leaves that are less densely pubescent, as is the rachis, and the corolla varies from purplish pink to purple, dark purple, or dark violet". In Australia, *S. mutabilis* hybridises with *S. jamaicensis* [*S. xadulterina* Urban & E. Ekman]. The other species with which *S. mutabilis* is said to hybridise are *S. cayennensis* (Rich.)M. Vahl and *S. indica* (L.)M. Vahl (Danser, 1929).

Of all species of *Stachytarpheta* in Australia, *S. mutabilis* is the tallest in habit, measuring up to 5 m in height. It has much larger and thicker leaves, robust and thick tomentose spikes of up to 10 mm diameter and large corolla of up to 2.5 mm long. Due to its large showy flowers, *S. mutabilis* is a very decorative garden plant.

According to Moldenke (1983), this species is known by many vernacular names in various parts of its vast range. In Australia it is known as "Pink Snakeweed" and in Sri Lanka as "Verbena rosada".

According to Adams (1972) the flowering and fruiting takes place "most of the year". Stanley (1986), however, has recorded the flowering period from "spring to autumn".

Affinity

Amongst Australian *Stachytarpheta* species, *S. mutabilis* is closely related to *S. australis* in its stems, leaves and inflorescence being always hairy. However, *S. mutabilis* may easily be identified by its stems, leaves and inflorescence being densely tomentose; rachis thick, 3-4 mm diam.; bracts large, tomentose abaxially, 8-12 by 2-3 mm; calyx about twice the size of *S. australis*, 8-14 by 2-3 mm; corolla large, 13-25 by 1.5-3 mm, bright red to scarlet or reddish-pink. In *S. australis*, the indumentum is thinner and shorter, and all the above named plant organs are almost half the size of *S. mutabilis*.

4. **Stachytarpheta australis** Mold., Phytologia 1 (1940) 470; Résumé Verbenac. etc. (1959) 188, 190, 195, 202, 203, 206, 468; Neal, Gard. Hawaii (1965) 725; Mold., Fifth Summary Verbenac. etc. 1 (1971) 327, 337, 342, 348, 351, 352, 907; H. St John, List & Summary Fl. Pl. Hawaii Isl. (1973) 291; López-Pal., Revista. Fac. Farm. Univ. Los Andes-Merida No. 15 (1974) 79; Mold., Phytologia 28 (1974) 426; Raj, Rev. Palaeobot. Palynol. 39 (1983) 398.

Type: *Schreiter s.n., Herb. BA 26/1347*, at Tartagal, in the department of Oran, Salta, Argentina, 28.ix.1925 (NY, holotype!). [See comments].

S. dichotoma auct. non (Ruíz Lopez & Pavón)M. Vahl: sensu Lopez-Pal., Verbenaceae Fl. Venezuela (1977) 528, p.p. quoad syn. *S. australis* Mold.; Mold., Sixth Summary Verbenac. etc. Phytologia Mem. II (1980) 440, p.p. quoad syn. *S. australis* Mold.; Mold. in Dassan & Fosb., Fl. Ceylon 4 (1983) 262, p.p. quoad syn. *S. australis* Mold.

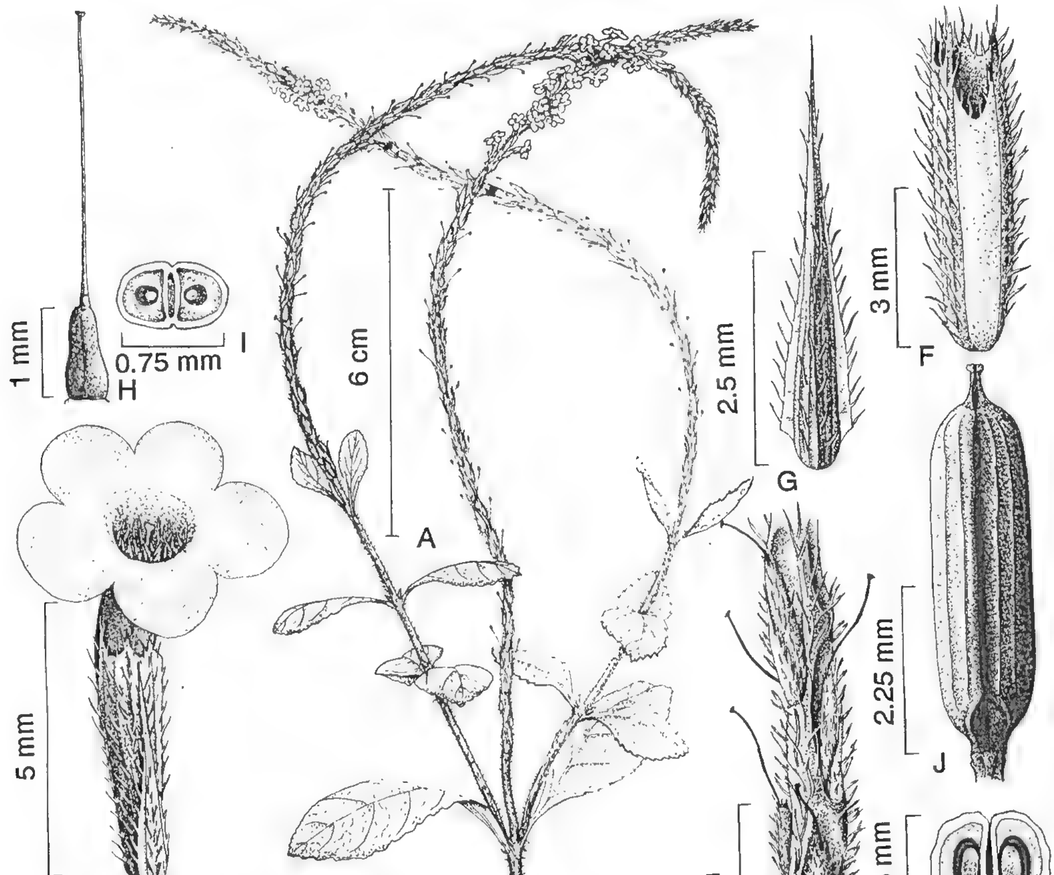


Fig. 5. *Stachytarpheta australis* Mold. (A-K, S. *Pickering* 2: DNA). A, habit drawing of a flowering twig; B, portion of stem showing hairs; C, portion of mature spike with corolla fallen off; D, flower with bract; E, corolla vertically cut open showing androecium and gynoecium; F, calyx; G, bract showing abaxial view; H, ovary; I, transverse section of ovary; J, fruit; K, transverse section of fruit.

Description (Fig. 1D & 5)

Erect and spreading shrub (0.6-) 0.8-1 (-1.5) m high. *Stem* dichotomously branched, slender, subterete or obscurely tetragonal; branchlets very slender, brownish, more or less densely pilose-pubescent. *Leaves* petiolate; lamina ovate, elliptic-ovate or oblong-elliptic, acute to subacute at the apex, cuneate-attenuate at base and prolonged into the petiole, crenate-dentate along the margin, (15-) 25-80 (-110) mm long, (10-) 15-40 (-50) mm wide, scabrous-puberulous or strigose-pubescent above, appressed pubescent beneath, chartaceous, somewhat brownish above in drying; petiole winged, pubescent, (3-) 5-20 (-30) mm long. *Spikes* slender, flaccid, pubescent, (12-) 18-30 (-45) cm long; rachis pubescent, 1-2 (-2.5) mm diam., furrows as wide as the rachis; peduncle short, pubescent, 3-12 mm long; bracts subulate to narrowly linear-lanceolate, pubescent abaxially, glabrous adaxially, 4-5 mm long, 0.5-0.8 (-1) mm wide, shortly ciliate and scarious along the lower margins, setaceous acuminate towards apex. *Flowers* sessile, half embedded in the furrows. *Calyx* compressed, surpassing the subtending bract, 4-6 (-7) mm long, 1-1.5 mm wide, pubescent outside, glabrous inside, bilobed at the top; teeth short, subulate, 0.5-1 mm long. *Corolla* pale blue or almost white with a trace of mauve, hypocrateriform, glabrous outside, shortly villous inside the upper half of the tube; tube cylindrical, (4-) 5-7 mm long, c. 1 mm diam.; lobes subequal, spreading, rounded or broadly ovate-orbicular, 1-2.5 (-3) mm long, 1-2 (-2.5) mm wide. *Stamens* included, inserted in corolla throat; filaments filiform, c. 1 mm long; anthers c. 1 mm; staminodes filiform, pubescent, 1-1.5 mm long. *Ovary* oblong, glabrous, somewhat compressed, 1-1.5 mm long, 0.5-1 mm in diam.; style included, filiform, glabrous, (3.5-) 4-6 mm long; stigma capitate. *Fruit* oblong, compressed, glabrous, faintly striate and postulate, 3-4 (-5) mm long, 1-1.5 mm wide.

Specimens examined (collections seen: Australian 17; non-Australian 20)

AUSTRALIA: NORTHERN TERRITORY: *Pickering s.n.*, Rapid Creek, Macmillans Road, Darwin, 9.vii.1980 (BRI, DNA); *Pickering s.n.*, Cameron Downs, 12.viii.1986 (DNA); *Pickering s.n.*, Eva Valley, 24.ii.1987 (DNA); *Pickering 2*, 9km S. Batchelor along railway line, 18.iii.1983 (BRI, CANB, DNA); *Rankin 2523*, Rapid Creek, McMillans Road, Darwin, 7.vii.1980 (BRI, DNA); *Rankin 2656*, Holms Jungle, 20.x.1982 (DNA).

QUEENSLAND: *Clarke s.n.*, Dayboro Road, Petrie, 24.vi.1976 (BRI); *Douglas s.n.*, Woombye, 15.xii.1955 (BRI); *Everist s.n.*, Buderim Mt., 6.i.1955 (BRI); *Kansella Bros s.n.*, Kallangur, Brisbane, 20.iii.1970 (BRI); *Lebler s.n. & Durrington 3*, around Huxley Dam, 1.6km N Childers, 21.i.1970 (BRI); *Lomax s.n.*, Aspley, Brisbane, 18.iii.1970 (BRI); *Mann s.n.*, Childers, -iv.1952 (BRI, CANB, NY); *Mann s.n.*, Petrie, 11.xii.1955 (BRI); *Rankin 2656*, Holmes Jungle, 20.x.1982 (DNA).

INDONESIA: *Hochreutiner 1104*, Java, Kotta batoe pres Buitenzorg, 1.v.1904 (L); *Lörzing 16639*, N. Sumatra, Upper Langkat, to the left of the river Wampu, 22.i.1933 (L).

PAPUA NEW GUINEA: *Stevens 54761*, Busama, Lae subdistrict, Marobe district, 1.i.1972 (BRI, CANB, GH, K, L, NSW); *Womersley 6860*, Dagua near Wewak, Sepik district, 7.xii.1954 (L, LAE).

NEW HEBRIDES: *McKee RSNH 24288*, Espiritu Santo, Big Bay (Malao), 14.ix.1971 (L).

HAWAIIAN ISLANDS: *O. & I. Degener 34415*, Mt Miles, 26.vii.1977 (AD, BISH); *Fosberg 53654*, Lawai Valley, Kauai, 3.iv.1971 (BISH, L). *Spence 321*, North end Munro trail, Lanaihale, 20.x.1973 (BISH, L).

FRENCH GUIANA: *Sagot 467*, Cayenne, 1857 (W); *Richard s.n.*, loc. cit., undated (P).

GUATEMALA: *Dziekanowski 3360 & al.*, 8km E of Jutiapa, 7·26·1979 (AD).

Distribution and ecology (Map 4)

In Australia, *S. australis* Mold. occurs in the tropical parts of Northern Territory and Queensland. Distribution in Northern Territory is in the Darwin region where it has been

recorded from near Darwin and Batchelor township. In Queensland this species is restricted to the south-eastern part of the state between 25° and 28°S and between 152° and 154°E. Most localities are around Brisbane but further north it has been collected from near Buderim and Childers townships.

In the protologue, this species is noted to occur in southern South America, Brazil, Paraguay, Uruguay, Argentina, Hawaii and Java. In addition to the above distribution, Moldenke (1971) has recorded it from Cuba, Jamaica, Leeward Islands, Trinidad and Tobago, Columbia, Venezuela, Surinam, Peru, Bolivia, Sierra Leone, Assam (India), Perak (West Malaysia), and Samoan Islands.

According to collectors' field notes, this species has been found growing in lateritic soil, red-brown loam soil and black-grey soil on top of creek-banks.

Comments

The occurrence of this species in Australia was first reported by Moldenke (1971) with cautious comments: "Is *Stachytarpheta australis* perhaps conspecific with *S. dichotoma*? Re-examination of the type of the latter would be required to settle this". In 1974, he confirmed his suspicion by regarding them as conspecific and wrote that "wherever the name '*Stachytarpheta australis* Moldenke' occurs, it should be changed to *S. dichotoma* (Ruíz Lopez & Pavón)M. Vahl". This view was later followed by Lopez-Palacios (1977) and Moldenke (1980) himself. During the present investigation, although a detailed study could not be undertaken, the types of *S. australis* and *S. dichotoma* have been examined and found to differ so greatly as to belong to two distinct species. *S. dichotoma* is regarded as a synonym of *S. cayennensis*.

In Australia, this species has been misidentified as *S. cayennensis* or *S. urticaefolia*. *S. australis* differs by its stem, leaves and inflorescence (spikes) being pubescent, flower-bracts narrowly subulate and mostly less than but sometimes up to 1 mm wide. To the naked eye, specimens of both taxa appear almost identical but the above mentioned differences become obvious when examined under a dissecting microscope.

In the protologue, the given collecting date for the type specimen is "September 29, 1925". The handwritten date on the herbarium label of the type sheet, however, is "28.ix.1925".

According to *Lomax s.n.* (BRI) and *Kansella Bros. s.n.* (BRI), the plant is suspected of killing cattle in Queensland, Australia.

Affinities

S. australis is closely allied to *S. cayennensis* and *S. mutabilis*. For similarities and differences see "Key to the species" and "affinities" under both the species.

5. **Stachytarpheta ×adulterina** Urban & E. Ekman in Urban, Ark. Bot. 22A (1929) 105; Mold., Résumé Verbenac. etc. (1959) 188, 190, 210, 468; Fifth Summary Verbenac. etc. 1 & 2 (1971) 327, 348, 630, 631, 647, 907; Adams, Fl. Pl. Jamaica (1972) 631; Mold., Sixth Summary Verbenac. etc. Phytologia Mem. II (1980) 317, 339, 441, 574; in Dassan. & Fosb., Fl. Ceylon 4 (1983) 252.

Type: *N.L. Britton 3241*, between Mandeville and Brown's Town, Manchester, Jamaica, 3-7.ix.1908 (NY, holotype!).

Valerianoides jamaicensis (L.)Kuntze x *V. mutabilis* (Jacq.)Kuntz: Britton in Bull. Torr. Bot. Club 37 (1910) 356, **hybrid formula.**

Stachytarpheta xtrimenii auct. non Rech.: sensu Danser, Ann. Jard. Bot. Buitenzorg 40 (1929) 19 [See comments].

S. jamaicensis (L.)M. Vahl x *S. mutabilis* (Jacq.)M. Vahl: Britton ex Mold., Prelim. Alph. List Invalid Names (1940) 42 in syn.

S. mutabilis (Jacq.)M. Vahl x *S. jamaicensis* (L.)M. Vahl: H.J. Lam, Bull. Jard. Bot. Buitenzorg Sér. III, 3 (1921) 6; Alston in Trimen, Handb. Fl. Ceylon 6 (1931) 230.
This hybrid formula is based on C.A. Backer's 1909 collection from Gunung Bunder, West Java, Indonesia. The specimen is most likely *Backer 31842*, noted as the type of *S. xspeciosa* Danser.

Description (Fig. 5E)

Shrub with stout branches, 0.6-3 m tall. *Stem* and branches obscurely tetragonal, pubescent but tending to be glabrescent when old. *Leaves* ovate-elliptic, broadly cuneate at base extending into petiole, acute at tip, coarsely crenate, (3-) 4-10 (-13) cm long, (2.5-) 3-5 (-7) cm wide, pubescent on both sides, somewhat hispid on veins beneath, dull-green, not as bullate as those of *S. mutabilis*; petiole winged, pubescent, 5-20 mm long. *Spikes* as thick as that of *S. jamaicensis* but thinner than *S. mutabilis*, (25-) 35-75 (-80) cm long, 5-6 mm diam.; rachis up to 4.5 mm diam., pubescent but tends to be glabrescent when mature; bracts oblong-ovate with scarious margins and extended tip, long acuminate, 7-9 mm long, ± 2 mm wide, glabrous but ciliate along margins, somewhat striate. *Calyx* sunken in the rachis-furrow, 8-9 mm long, c. 2 mm wide, puberulous-glabrescent and with a few glands outside, glabrous inside, equally 4-toothed. *Corolla* deep purplish-blue, pinkish-lilac or with some shade of violet, 11-16 mm long, 8-12 mm diam. at rim, protrudes c. 5 mm or more beyond calyx-tube; tube cylindrical, somewhat dilated at the top end, sparsely glandular hairy or almost glabrous outside, villous-pubescent inside the upper half. *Stamens* inserted in the corolla-throat, included; filaments 1.5-2.5 mm long, pubescent; anther-lobes divergent, unequal; staminodes 1.5-2.5 mm long, pubescent. *Ovary* elliptic-oblong, glabrous, 1-2 mm long, ± 1 mm diam.; style filiform, glabrous, included, 10-13 mm long; stigma capitate. *Fruit* not known.

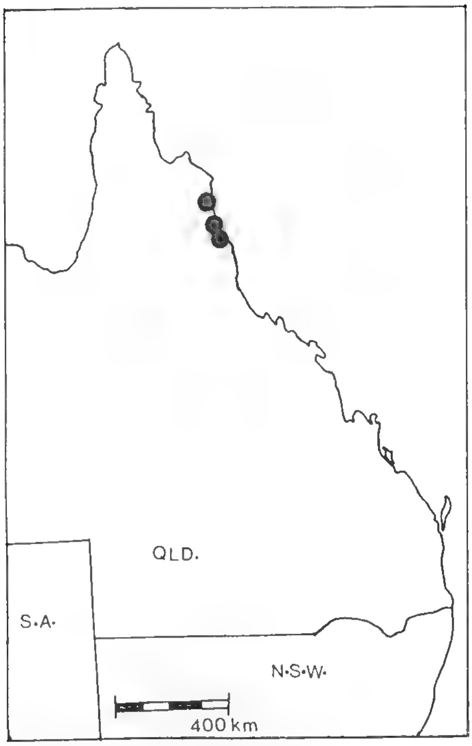
Specimens examined (collections seen: Australian 3; non-Australian 2)

AUSTRALIA: QUEENSLAND: *Everist 5123*, Port Douglas, 20.v.1952 (BRI, CANB 2 spec., LAE, NY); *Hatfield s.n.*, Rossville, via Cooktown, 20.iv.1956 (BRI 004812); *Stephens 11725*, Smithfield, 11.x.1947 (QRS).

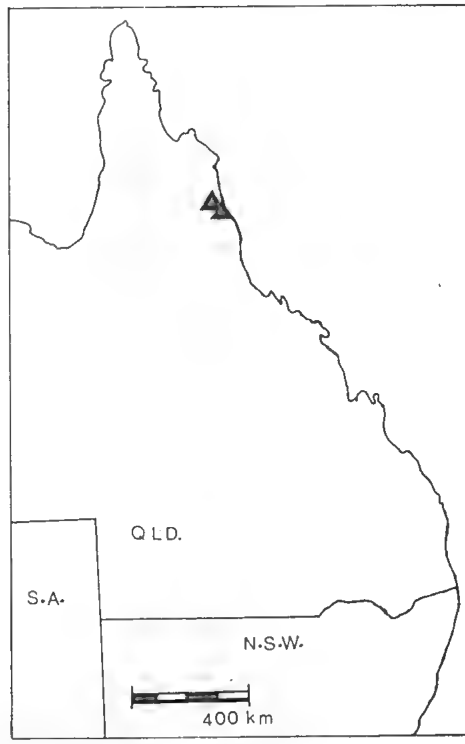
JAMAICA: *Britton 3241*, between Mandeville and Brown's Town, Manchester, 3-7.ix.1908 (NY, holotype!).

Distribution (Map 5)

In Australia, *S. xadulterina* is known only from the east coast of Cape York Peninsula where it is known to occur in the area between Cooktown and Cairns. From overseas, one collection is known from Papua New Guinea and the type collection from Jamaica was the only other specimen available for examination. In addition to this, Moldenke (1983) has recorded its occurrence in Sumatra (Indonesia), Haiti, Cuba, the Seychelles Islands and New Zealand. According to Moldenke (1983), this hybrid "is thought to have been introduced in New Zealand from the Seychelles Islands". The cold climate of New Zealand, otherwise is not suitable for its natural growth.



Map 5. Distribution of *S. xadulterina*



Map 6. Distribution of *S. xtrimenii*

Comments

Adams (1972) has expressed the view that *S. xadulterina* "is intermediate in character between *S. mutabilis* and *S. jamaicensis* and is strongly suspected to have originated as a hybrid between these two species".

According to Moldenke (1983), "the natural hybrid between *S. jamaicensis* (L.)M. Vahl and *S. mutabilis* (Jacq.)M. Vahl has the height of *S. mutabilis*, but the general facies of *S. jamaicensis*. Danser (1929) gives a detailed description of its variable morphologic characters, but unfortunately uses the name, *S. xtrimenii* Rech., for it by mistake. Both Danser and Rechinger described their respective plants as hybrids between "*S. indica*" and *S. mutabilis*. However, Rechinger's "*S. indica*" was actually *S. urticaefolia* (Salisb.)Sims, while Danser's was *S. jamaicensis*. Danser's plant, therefore, was not *S. xtrimenii*, but was *S. xadulterina*".

In his comments on Danser's cross pollination, Moldenke (1983) states: "Danser notes that the description of Rechinger's plant does not agree in all particulars with his plant, but the curator of the Rechinger herbarium in Vienna regarded both plants as the same when he submitted some material of his plant to them. Danser never found *S. xadulterina* wild in Java; he produced his plants by artificial pollination in 1926. He predicts, however, that the hybrid is likely to be found wherever the two parental species grow in proximity, either in the wild or in cultivation. He secured no fruit when he pollinated *S. mutabilis* pistil with *S. jamaicensis* pollen, but the reciprocal cross was very successful, yielding 30 plants. Of these, 14 were typical *S. jamaicensis* and 16 were the hybrid."

Similar to Danser's hybrid, one of Hatfield's (s.n.) collection from Rossville, Queensland, was also "produced by deliberate hand pollination of *S. mutabilis* with *S. jamaicensis*". The collection from Smithfield by S.E. *Stephens 11725*, however, seems to be the first natural hybrid collected in Australia. A better collection was subsequently made by *S.L. Everist 5123* from Port Douglas, Queensland.

According to collectors' field notes, all hybrid collections from Australia have been found in places where the two parent species were growing close to each other.

Affinities

S. xadulterina is intermediate in character between *S. mutabilis* and *S. jamaicensis*. It is nearest to *S. xtrimenii* in its stem and rachis being pubescent-glabrescent; leaves pubescent; flower-bracts oblong-ovate, with scarious margins, up to 9 x 2 mm; calyx about the same length, pubescent-glabrescent outside and corolla purplish-blue to pinkish-lilac. However, *S. xadulterina* can be distinguished by its spikes being c. 10 mm diam. after anthesis; rachis thicker, up to 4.5 mm diam.; flower-bracts glabrous and calyx equally 4-toothed. The spikes in *S. xadulterina* are generally as thick as that of *S. jamaicensis* but thinner than *S. mutabilis*. The spikes in *S. xtrimenii* are less than 10 mm diam. after anthesis; rachis 2.5-3 (-3.5) mm diam.; bracts sparsely pubescent to glabrescent abaxially and calyx unequally 4-toothed.

6. **Stachytarpheta xtrimenii** Rech. in Feddes, Repert. Sp. Nov. Regni Veg. 11 (1913) 189; Danser, Ann. Jard. Bot. Buitenzorg 40 (1929) 18-19; Alston in Trimen, Handb. Fl. Ceylon 6 (1931) 230; Alston, Kandy Fl. (1938) 64; Mold., Amer. Midl. Naturalist 59 (1958) 341; Résumé Verbenac. etc. (1959) 191, 199, 222, 349; Fifth Summary Verbenac. etc. 1 & 2 (1971) 281, 327, 333, 351, 369, 630-632; Sixth Summary Verbenac. etc. Phytologia Mem. II (1980) 265, 269, 318, 323, 341, 360, 439, 441; in Dassan. & Fosb., Fl. Ceylon 4 (1983) 251.

Type: *Rechinger 2285*, Kandy, Ceylon, -xi.1905 (W, holotype n.v.).

S. indica (L.)M. Vahl x *S. mutabilis* (Jacq.)M. Vahl: Rech. in Feddes, Repert. Spec. Nov. Regni Veg. 11 (1913) 189, **hybrid formula** for *trimenii* Rech.; Alston in Trimen, Handb. Fl. Ceylon 6 (1931) 230.

S. xabortiva Danser, Ann. Jard. Bot. Buitenzorg 40 (1949) 15, **syn. nov.**; Mold., Résumé Verbenac. etc. (1959) 155, 190, 222, 347-349; Fifth Summary Verbenac. etc. 1 & 2 (1971) 258, 327, 368, 629, 631; Sixth Summary Verbenac. etc. Phytologia Mém. II (1980) 248, 317, 360, 440, 441.
Type: Produced by the author (Danser) by artificial hybridisation in 1927 (?BO, n.v.).

S. xspeciosa Danser, Ann. Jard. Bot. Buitenzorg 40 (1929) 21, fig. 9, tables 1 & 10 [not *S. speciosa* Pohl, 1847]; Mold., Résumé Verbenac. etc. (1959) 349, in syn.; Backer & Bakh.f., Fl. Java 2 (1965) 597; Mold., Fifth Summary Verbenac. etc. 2 (1971) 631, in syn.; Sixth Summary Verbenac. etc. Phytologia Mém. (1980) 439 in syn.
Type: *Backer 31842*, Goenoeg Boender, Buitenzorg, Java, Indonesia, 1909 (BO or L, syntype n.v.); *Bakhuizen 5302*, loc. cit. 16.iv.1921 (L, syntype!).

S. jamaicensis (L.)M. Vahl x *S. mutabilis* (Jacq.)M. Vahl: Danser, Ann. Jard. Bot. Buitenzorg 40 (1929) 21, in syn., hybrid formula for *S. xspeciosa* Danser.

S. trimenii Fedde, Just's Bot. Jahresber. 57 (1938) 890, sphalm.

Description (Fig. 5F)

Shrub branching from the base, tending to be subscandent, 0.7-2 (-3) m high. *Stem* woody towards the base, sparsely pubescent; branches tetragonal, pubescent. *Leaves* elliptic or ovate-elliptic, cuneate at base; lamina merging into petiole, crenate-serrate, acute at tip, 5-10

cm long, 2.5-6 cm wide, dark-green when alive, somewhat blackish when dry, sparsely hairy above, pubescent below; petiole winged, pubescent, 5-20 mm long. *Spikes* erect, thinner and less pubescent than *S. mutabilis* but thicker and more hairy than *S. cayennensis*, becoming glabrous or sparingly pilose, 40-80 cm long, 5-6 mm diam.; rachis sparingly short pilose, 2.5-3 (-3.5) mm diam.; bracts oblong-ovate, with scarious ciliate margins and long slender tip, acuminate, striate, almost as long as the calyx, 8-9 mm long, c. 2 mm wide, glabrous or sparsely pubescent abaxially. *Calyx* sunken in the rachis-furrow, 4-toothed on top, with a short slit on adaxial side, 9-10 mm long, 2 mm wide, pubescent outside, glabrous inside. *Corolla* varies from bright blue to violet-purple, purplish-pink, deep purple or dark violet, glabrous outside, villous inside the tube in the upper half, the lobes ± rounded, spreading to 15 mm diam.; tube cylindrical, slightly curved, somewhat dilated at the top, 12-15 mm long, 1.5-2.5 mm diam. *Stamens* inserted in the corolla-throat, included; filaments filiform, 1-2 mm long, pubescent; anthers with divergent lobes, 1-2 mm long, ± 1 mm wide; staminodes filiform, villous, 1.5-2 mm long. *Ovary* elliptic-oblong, glabrous, 1.5-2 mm long, ± 1 mm diam.; style almost included or slightly protruding above the corolla-tube, filiform, glabrous, 12-14 mm long; stigma capitate. *Fruit* oblong, ± cylindrical, glabrous, ± 4 mm long, c. 1.5 mm diam.

Specimens examined (collections seen: Australian 2, non-Australian 8)

AUSTRALIA: QUEENSLAND: *Brass 33493*, Kuranda, 7.viii.1966 (BRI, L); *Hopkinson 2*, Black Mountain road c. 3km from Kuranda, 8.iii.1973 (BRI, QRS).

INDONESIA: *Bakhuizen 5302*, Goenoeg Boender, Buitenzorg, Java, 16.iv.1921 (L); *Bakhuizen 6581*, Java, Batavia, Buitenzorg, 19.xii.1924 (BO, L); *Danser 6664*, Java Buitenzorg, 1.vii.1927 (BO); *Danser 6665*, loc. cit. 1.vii.1928 (L); *Danser 6904*, loc. cit. -xi.1928 (L); *Rant 234*, hills behind Saja Road, Karang Pandjang, Ambon, Molucca, 11.vi.1929 (BO, 2 spec.).

HAWAIIAN ISLANDS: *Degener 21485*, Hanalei Valley, Kauai, 29.xii.1951 (BISH, 2 spec.).

Distribution (Map 6)

In Australia, the hybrid *S.* x*trimenii* is known only from Kuranda, north of Cairns in Queensland. Collections from overseas have been examined from the Indonesian Islands Java and Ambon, and the Hawaiian Island Kauai. In addition to this, Moldenke (1983) has recorded it in the wild from Mysore in southern India and from Kandy and Matale districts in Sri Lanka.

Comments

The hybrid *S.* x*trimenii* is recorded here for the first time from Australia. Previously it was identified as "*S. mutabilis*", "*S. urticaefolia*" or as a probable hybrid between *S. mutabilis* and *S. urticaefolia*.

According to Moldenke (1983) "This natural hybrid is very similar to *S. mutabilis* in its general characters, but the plant is usually lower in growth, the leaves are usually smaller, often more obtuse apically, and less densely pubescent, the rachis is only sparingly short-pilose, and the corollas vary from purplish-pink to purple, deep purple or dark violet and are very hairy within. It is actually a hybrid between *S. urticaefolia* (Salisb.)Sims [*S. cayennensis*] and *S. mutabilis* (Jacq.)M. Vahl-the ancestry given by Rechinger, by Danser, and by Trimen is incorrect because Danser consistently misused the name "*S. jamaicensis*" for what is actually *S. urticaefolia*, while Trimen, Rechinger, and Alston misused the name "*S. indica*" for the same plant."

Moldenke (1983) further states that "the hybrid has a more slender but stronger stem than does *S. mutabilis*, and with a little pruning can be trained to form a small treelet which will bloom profusely all year and make a splendid addition to tropical gardens. Its pollen is more fertile than one would expect from parental species so very different in appearance. Pistil fertility, however, is not so good — usually only 2 or 3 seeds are formed on an entire spike and from 150 seeds only 5 seedlings were secured by Danser. These he was able to grow to maturity in Java and found that they differed notably from each other, with the two sets of parental characters present in different degrees and combinations of each."

Danser (1929) described *S. xabortiva* as a hybrid between *S. cayennensis* (Rich.)Vahl and *S. mutabilis* (Jacq.)Vahl. As mentioned under *S. cayennensis*, this taxon is synonymous with *S. urticaefolia* (Salisb.)Sims. Danser crossed *S. mutabilis* with *S. cayennensis* and *S. cayennensis* with *S. mutabilis*. According to Danser, the pollination of a spike of *S. mutabilis* with pollen of *S. cayennensis* in October 1926 had no success. Hardly any seeds were produced and the few, which were completely developed, did not germinate. In reciprocal pollination in April 1926, Danser pollinated 4 spikes of *S. cayennensis* with pollens of *S. mutabilis* and obtained about 200 seeds. The exact counting of such seeds was not possible because the border between developed and not developed seeds could not be drawn. The result was strange as out of 98 plants obtained only 4 looked like the hybrids, the remaining ones were pure *S. cayennensis*.

"A strange property of the 4 hybrid-plants was that their leaves, especially the ones produced in the first month, were mainly abnormal. Their edges grew slower than the middle part of the lamina resulting in irregularly umbonate leaves with margins often irregularly torn. When the hybrids grew to about half a metre tall they developed only few centimetre long spikes during rainy season and even less in the dry season. In both cases, the spikes dried out at a stage of their development."

S. xtrimenii is less densely tomentose than *S. mutabilis* but much more hairy and robust than *S. cayennensis* (= *S. urticaefolia*). According to Wagner et al. (1990), "the hybrids are very similar to *S. mutabilis* but are usually lower in habit with smaller leaves that are less densely pubescent, as is the rachis, and the corolla varies from purplish pink to purple, dark purple, or dark violet."

Affinities

S. xtrimenii is intermediate in character between *S. mutabilis* and *S. cayennensis*. In general appearance, however, it seems to be nearest to *S. xadulterina*. For similarities and differences see "Key to the species" and "Affinities" under *S. xadulterina*. Also see under "Comments" the similarities and differences of *S. xtrimenii* with *S. mutabilis* and *S. cayennensis*.

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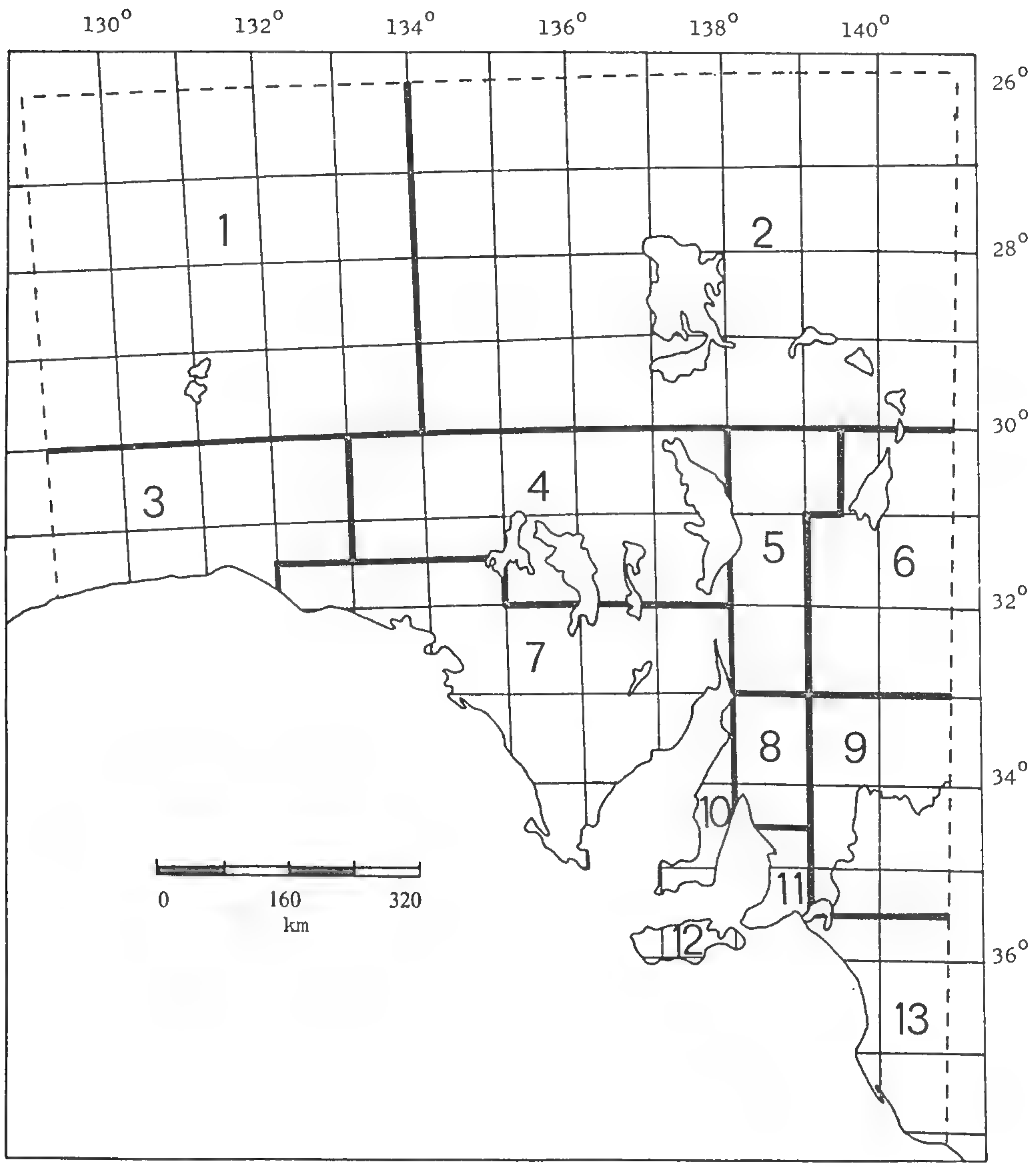
REGIONS OF SOUTH AUSTRALIA ADOPTED BY THE STATE HERBARIUM — ADELAIDE

1. North-western
2. Lake Eyre
3. Nullarbor
4. Gairdner-Torrens
5. Flinders Ranges
6. Eastern
7. Eyre Peninsula
8. Northern Lofty
9. Murray
10. Yorke Peninsula
11. Southern Lofty
12. Kangaroo Island
13. South-eastern



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10-30 specimens should be cited for each species (or subspecific taxon), although this may be varied under certain circumstances. The author may decide whether or not to include dates of collections and the sequence, provided a constant pattern is adhered to throughout a paper.

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All correspondence concerning the journal should be addressed to:

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A TAXONOMIC REVISION OF CENTROLEPIS (CENTROLEPIDACEAE) IN AUSTRALIA

D. A. Cooke

Animal and Plant Control Commission of South Australia
GPO Box 1671, Adelaide, South Australia 5001

Abstract

Centrolepis in Australia is revised and twenty species are recognised. This revision is based on morphological features that are discussed in relation to the biology of the genus. One new species, *C. curta*, and a new subspecies, *C. strigosa* subsp. *rupestris*, are described and illustrated. The new combinations *C. monogyna* subsp. *paludicola* and *C. strigosa* subsp. *pulvinata* are made.

Introduction

Centrolepis is a genus of small annual and perennial monocots. It forms, with *Aphelia* and *Gaimardia*, the minor family Centrolepidaceae. The family has its main centre of diversity in Australia with 29 species; a few occur in New Zealand, south-eastern Asia and South America. The close affinity of the Centrolepidaceae to the Restionaceae, and its remoteness from the two genera segregated by Hamann (1976) as the Hydatellaceae, are widely recognised in contemporary systems of classification (Cronquist, 1981; Dahlgren & Clifford, 1982; Takhtajan, 1980).

Taxonomic history

The genus first became known from material of the near-coastal species sent to Europe by the early botanist-explorers and collectors. In 1770 Banks and Solander on the Endeavour collected specimens of *Centrolepis*, now referred to *C. banksii* and *C. exserta*, that they tentatively labelled as species of *Schoenus* (Cyperaceae). Labillardière (1804) based the new genus Centrolepis, which he placed under Monandria Monogynia in the Linnaean system, on a Tasmanian specimen.

Robert Brown (1810), using Banks' and Solander's material and his own collections from the voyage of the Investigator around Australia in 1801-4, drafted manuscript epithets for a further twelve *Centrolepis* species. However, in the *Prodromus* he divided these between two new genera, *Alepyrum* (three species) and *Devauxia* (nine species, including Labillardière's *C. fascicularis*). Recognising the broad affinities of these genera, he included them in his concept of Restiaceae. Roemer & Schultes (1817) reinstated the name *Centrolepis* for *Devauxia*; Nees (1841, 1846) described three more species from Preiss and Drummond collections.

The first revision of Centrolepidaceae was produced by Hieronymus (1873), who reduced *Alepyrum* and *Devauxia* to synonymy under *Centrolepis*. Hieronymus' generic concept was maintained by Bentham (1878) and is retained in this revision.

Ecology

Centrolepis is widespread in heath, scrub, herbfield, woodland and open forest, but absent from closed forests and other vegetation with a dense shading canopy.

The majority of species are annuals adapted to habitats with seasonal rainfall delimiting the growing season, and growth within this period further limited by the availability of nutrients or water. They may be categorised as stress-tolerant ruderals in the system of Grime (1979), occupying a range of niches from pioneers of such temporary microhabitats as margins of seasonal pools to permanent members of the sparse herb stratum in heath, woodland or mallee communities. Often several species co-exist, together with other stress-tolerant ruderals such as *Aphelia* and *Isolepis*, on otherwise bare ground or in moss beds. Their reduced and condensed structure is associated with the short growing season and limited resources. There is a gradation between relatively ruderal species with high seed production (high values of *r*, the intrinsic rate of increase) and species closer to a stress-tolerator strategy. The latter are characterised by more reduced structure: simpler inflorescences, fewer seeds per plant, and either a scapeless habit or the gracile "shadowless plant" strategy described for a range of other arid zone therophytes by Shreve (1964).

A rough measure of *r* was estimated from the range of available herbarium material as l_n(median number of seeds/pseudanthium X median number of pseudanthia/head X median number of heads/plant). The annual taxa are listed in order of this quantity in Table 1, showing a gradation between species with specialised stress-tolerator niches and ruderals such as *C. banksii* with much higher seed production. Although *r* is a parameter of populations rather than of species, because herbarium sheets of small annuals are effectively population samples these figures indicate the relative values of *r* achieved by populations of these species.

Centrolepis alepyroides	2.4	*C. aristata*	6.3
C. inconspicua	2.4	*C. cephaloformis* subsp. *cephaloformis*	6.3
C. muscoides	4.4	*C. polygyna*	6.6
C. humillima	4.7	*C. strigosa* subsp. *rupestris*	6.8
C. caespitosa	4.7	*C. strigosa* subsp. *pulvinata*	6.9
C. mutica	5.1	*C. curta*	6.9
C. cephaloformis subsp. *murrayi*	5.3	*C. eremica*	7.2
C. glabra	5.6	*C. strigosa* subsp. *strigosa*	7.4
C. drummondiana	6.2	*C. exserta*	8.1
C. pilosa	6.2	*C. banksii*	8.1

Table 1. Annual *Centrolepis* taxa listed by l_n seed number/plant

The annual species appear to form seed banks in a range of soil types; *Centrolepis* seedlings were obtained from soil samples taken from *Eucalyptus camaldulensis* woodland in the You Yangs (Carroll & Ashton, 1965), and *C. strigosa* was the most abundant annual to germinate from samples of heathland sands from Cranbourne, Victoria. These species occur as opportunists in disturbed habitats; *C. strigosa* has been recorded as a plagioseral species in heath mined for sand, *C. cephaloformis* on former gold workings and *C. pilosa* on overburden dumps.

Centrolepis species have occasionally attracted attention as weeds, eg. *C. fascicularis* in Brisbane gardens (Bailey, 1906) and *C. banksii* in ricefields (Cook, 1974). Swarbrick (1984) lists herbicides registered for control of *C. strigosa* in maize and vegetable crops in eastern Australia, indicating its perceived economic importance.

Seedling development

Freshly collected seed of *C. aristata*, *C. cephaloformis*, *C. drummondiana*, *C. pilosa*, *C. polygyna* and *C. strigosa* was sown in pots in late spring 1979. In each species germination occurred 3-5 months later, implying some mechanism of innate dormancy; a second

germination of *C. cephaloformis* from the original sowing was observed in autumn 1981. Seedlings of *C. humillima* and *C. inconspicua* were also seen in herbarium collections.

In all species examined, germination was epigeal of the type A of Dahlgren & Clifford (1982), the testa being raised on the apex of an erect, terete, photosynthetic cotyledon about 3 mm long. The first plumular leaves emerged through an opening in the sheathing base of the cotyledon as illustrated for *C. strigosa* by Hieronymus (1873). Succeeding leaves showed a transition to the mature leaf form and texture of the species.

Perennial growth

Some species in habitats with no seasonal water deficit have a perennial hummock-forming habit. Unlike the perennial restiads, these species lack well-developed rhizomes. Their stems are leafy and consist of much low-density pith and cortex containing scattered vascular bundles, and for this reason were likened to the culms of other monocots by Cutler (1969); they differ from those of annual *Centrolepis* species only in their indeterminate growth.

Plants of *C. cephaloformis* and *C. strigosa*, which require a cold period to initiate flowering, were maintained in the vegetative state for 18 months in a heated glasshouse. They continued to produce apical growth and adventitious roots like the perennial species.

Leaf and bract morphology

I interpret the types of leaf and bract developed in *Centrolepis* as products of a reduction series from a linear phyllome containing three vascular bundles and divided into a sheathing base and a photosynthetic lamina. The leaves of the related genus *Gaimardia* retain this structure (Fig. 1A).

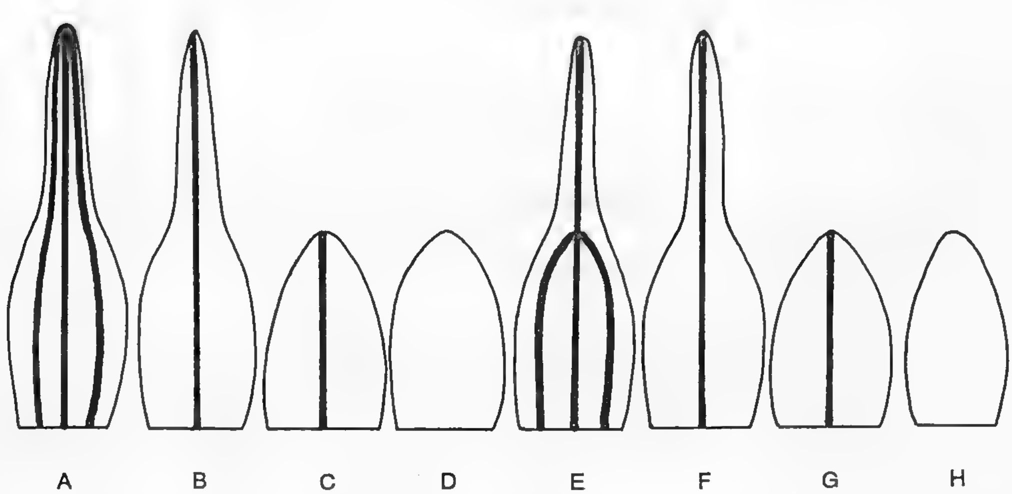


Fig. 1. A, Diagramatic leaf of *Gaimardia*; B, *Centrolepis*; C, cataphyll of *C. humillima*; D, cataphyll of *Centrolepis*; E, primary bract of *C. aristata*; F, primary bract of *C. polygyna*; G, primary bract of *C. monogyna*; H, secondary bract of *C. aristata*.

In all *Centrolepis* species, each leaf has an open scarious sheath containing one central vascular bundle (B). The leaves may have been derived from an original equitant type, and remain manifestly distichous in the relatively primitive species such as *C. aristata*. Similarly distichous and subequitant leaves occur in the primitive restiad *Anarthria* (Johnson & Briggs, 1981), seedlings of some other restiads, and the most primitive species of *Aphelia*. The basically distichous phyllotaxy is obscured in most species by the crowding of leaves from the numerous growing points forming each tuft, sometimes producing a false spiral phyllotaxy in species such as *C. strigosa* with very numerous linear leaves.

The last leaf produced before the inflorescence is further reduced. In *C. aristata* the lamina of this leaf is shortened; in most other species it is completely suppressed, leaving a short scarious sheath that I have termed a cataphyll (Cooke, 1980). This may retain the vascular bundle, as in some specimens of *C. humillima* (C), but more often lacks vascular tissue (D).

The primary bracts are a pair of phyllomes with their sheathing bases modified to enclose the inflorescence, and are comparable in anatomy and vestiture to the leaves in each species. In *C. aristata* (E), the sheath contains three vascular bundles, the lateral pair anastomosing and terminating at the junction of the sheath and lamina (Arber, 1922). Three bundles are also visible in the bract bases of some other species, sometimes with two smaller additional lateral bundles, but in many species only the central bundle is present (F). The primary bracts may bear laminae differing from leaf laminae only in their reduced length. There appears to be a general trend towards the reduction and loss of the lamina from one or both primary bracts (G).

The secondary bracts are defined as those which subtend branches within the inflorescence (Cooke, 1980). They are reduced to hyaline or scarious structures one cell thick, lacking vascular tissue (H) and apparently homologous to the leaf bases, or are absent.

Floral structures

As previously described (Hamann, 1962; Cooke, 1980), the inflorescence is a cymose head enclosed by two primary bracts. These may be separated by a short internode, one or both bracts subtending a cyme; or apparently opposite due to suppression of the internode.

The individual male and female florets are reduced to solitary stamens and carpels showing little gross morphological variation between species. The unit inflorescence is a pseudanthium, interpreted as a condensed monochasium (Cooke, 1980) with a basal stamen and a compound gynoecium of unicarpellate pistils apparently distichous on a false axis or gynophore derived from their successively longer stipes. Each carpel has two vascular bundles, the dorsal bundle running into the style and the ventral bundle supplying the ovule (Prakash, 1969).

The styles with their linear stigmas on the ventral side form a "brush" to intercept windborne pollen; the stigmatic papillae are usually microscopic, but in three species are enlarged and branched, increasing the efficiency of the brush. In *C. pilosa* and *C. polygyna* the first stigmas became functional 1-2 days before the corresponding anther dehisced, therefore the individual pseudanthia may be called proterogynous. However, due to the successive maturation of pseudanthia, heads with several pseudanthia have stigmas and anthers ripe simultaneously; Keighery (1982) found that all species examined were self-fertile. The number of pseudanthia and carpels are important diagnostic characters and reflect the life strategy of the species. In the perennial *K*-strategist or stress-tolerant competitor *C. monogyna* each pseudanthium is reduced to one carpel with an associated stamen.

Fruit and seed

The fruit, a compound structure of scarious follicles, is quite uniform throughout the genus. Each follicle dehisces along a line of weakness adjoining the dorsal vascular bundle.

The testa of the seed is thin and, except in *C. humillima*, without sculpture. Passive dispersal occurs when seeds are shaken from the scapose heads, their small size allowing transport in runoff water or in mud on the feet of birds; or the whole dead plant may function as a disseminule as in *C. cephaloformis* subsp. *cephaloformis*. The suppression of the scape in other species with sessile heads may be an adaptation to atelechory, retaining in a favourable microsite the comparatively few seeds produced.

Vestiture

The hairs and papillae of *Centrolepis* species conform to a narrow range of types, and the branched hairs typical of *Gaimardia* (Cutler, 1969) are never produced. They are all eglandular and developed from a basal epidermal cell which is normally empty, but rarely becomes cystolithic with an accumulation of silica. Cystoliths are occasionally also found in slightly enlarged epidermal cells of glabrous species such as *C. aristata*.

A papilla consists of an outgrowth from the basal cell projecting beyond the plant surface. Hairs consist of a simple chain of up to 8 cylindrical thin-walled cells; those on leaves and bracts are 0.025-0.06 mm wide, usually stiffly perpendicular to the surface and persistent. Hairs on leaf sheaths may be crisped due to the collapse of the cells, and those produced on scapes are lax with very thin cell walls, c. 0.01 mm wide and usually caducous.

In dried material of some glabrous species shrinking of the parenchyma may cause wrinkles in the overlying epidermis. These wrinkles may resemble papillae or appressed microscopic hairs, and were described as such by Cutler (1969) and Curtis (1982).

A major function of the hairs is likely to be reduction of transpiration. The majority of species, except from moist habitats, have leaves which are either hairy (eg. *C. strigosa*) or sclerified (eg. *C. polygyna*).

Chromosome number

Diploid numbers of 20 in *C. strigosa* and 46 or 48 in *C. aristata* (Hamann, 1960) and of 26 in *C. fascicularis* (Briggs, 1966) have been reported. The diploid number of 40 or 42 in *C. cambodiana*, an Asian species related to *C. strigosa* (Larsen, 1963) confirms the presence of at least two levels of ploidy in the genus. A generic base number cannot be deduced with certainty from the range of chromosome numbers in the few species investigated.

CENTROLEPIS Labill.

Centrolepis Labill., Nov. Holl. Pl. Sp. 1:7 (1804); Roemer & Schultes, Syst. Nat. 1:43 (1817); Desv., Ann. Sci. Nat. (Paris) 13:42 (1828); Endl., Gen. Pl. 120 (1836); Kunth, Enum. Pl. 3:489 (1841); Walp., Ann. Bot. 1:896 (1849); Hieron., Abh. Naturf. Ges. Halle 12:209 (1873); F.Muell., Fragm. Phyt. Aust. 8:237 (1874); Benth., Fl. Austral. 7:202 (1878); Benth. & J.D. Hook., Gen. Pl. 3:1026 (1883); Hieron., Pflanzenfam. 2(4):15 (1888); Bailey, Queensl. Fl. 6:1719 (1902); Rodway, Tasm. Fl. 231 (1903); J. Black, Fl. S. Aust. 1:102 (1922); Ewart, Fl. Vict. 260 (1931); Ding Hou, Fl. Males. 5:422 (1957); Hutchinson,

Fam. Fl. Pl. 2:700 (1959); Hamann in Melchior, Syll. Pflanzenfam. 2:559 (1964); Hamann, Bot. Jahrb. Syst. 96:158 (1975).

Type species: C. fascicularis Labill.

Centrosepis R. Hedwig, Gen. Pl. (1806), sphalm. orthog.

Devauxia R. Br., Prodr. 252 (1810); Gaudich., Voy. Uranie. 419 (1829); Nees in Lehm., Pl. Preiss. 2:70 (1846); Steudel, Syn. Pl. Glum. 2:266 (1855).

Type species: D. billardieri R. Br. (Lecto. chosen here being a synonym of the type species of *Centrolepis*, for which *Devauxia* was an avowed substitute, see Brown p. 252).

Brown deliberately spelled this name *Devauxia*, from what he considered the correct Latin form of the French surname Desvaux. In the same way, he formed the generic name *Lechenaultia* (Goodeniaceae) from the surname Leschenault. Although widely emended to *Desvauxia* by subsequent authors, the original spelling is here reinstated as required by the International Code of Botanical Nomenclature, Article 73.

Alepyrum R. Br., Prodr. 253 (1810); Roemer & Schultes, Syst. Nat. 1:44 (1817); Endl., Gen. Pl. 120 (1836); Nees in Lehm., Pl. Preiss. 2:71 (1846); Steudel, Syn. Pl. Glum. 2:266 (1855); J.D. Hook., Fl. Tasman. 2:77 (1858).

Type species: A. polygynum R. Br. (Lecto. chosen here).

Alepyrum Hieron., Abh. Naturf. Ges. Halle 12:217 (1873); Pflanzenfam. 2(4):16 (1888); nom. illeg., non R. Br.

Type species: A. pallidum (J.D. Hook.) J.D. Hook. (The only species retained in this genus by Hieronymus).

Pseudalepyrum Dandy, J. Bot. (Lond.) 70:330 (1932); Hutchinson, Fam. Fl. Pl. 2:700 (1959).

Type species: P. pallidum (J.D. Hook.) Dandy (Lecto. chosen here being a synonym of the type species of *Alepyrum* Hieron., for which *Pseudalepyrum* was an avowed substitute).

Small tufted annual or cushion-forming perennial herbs. *Root system* fibrous with adventitious roots produced from leaf axils. *Main stem* in annual species usually very short and densely branching to form a leafy tuft; in perennials, of indeterminate growth with imbricate leaves. *Leaves* crowded, with dilated membranous open sheathing bases and linear to subulate 1-veined laminae. Uppermost leaf reduced, usually lacking a lamina. *Inflorescence* a terminal cymose head enclosed by 2 primary bracts, often scapose on a single erect internode. Secondary bracts veinless, hyaline or scarious, 2-3 per pseudanthium or absent. *Florets* minute, unisexual, lacking receptacles or perianths, arranged in 1-many sessile pseudanthia comprising 0-1 male and 1-30 female florets. *Male floret* reduced to a solitary stamen; filament usually capillary, glabrous; anther dorsiversatile, unilocular, dehiscing by a longitudinal slit. *Female floret* reduced to a solitary carpel, usually stipitate; ovary ovoid, hyaline, unilocular with 1 pendulous orthotropous ovule. Ovaries within each pseudanthium united, alternating in 2 rows on a false axis (gynophore) incorporating the vascular bundle to each ovary and the lower styles; distal portion of styles free, filiform, exserted, with stigmatic papillae along the adaxial side. *Fruit* compound, dry, membranous, of 1-seeded carpels each dehiscing by an abaxial slit. *Seed* ovoid to fusiform, endospermic with a small apical embryo.

The genus contains 20 species in Australia: 19 are endemic and one extends to New Guinea. The world distribution is centered on Australia; at least one other species occurs in New Guinea and two in south-east Asia extending to Hainan. Three others are endemic to New Zealand.

Key to species of *Centrolepis* in Australia

1. Multicellular hairs present on leaves and/or on primary bracts 2

   Multicellular hairs absent (plants completely glabrous or rarely bearing scattered microscopic papillae) 8

2. Perennials; pseudanthia with 1-4 carpels 3

   Annuals; pseudanthia with 4-12 carpels 4

3. Primary bracts pilose or with a few hairs, terminating in subulate laminae subequal to the bract bases .... 12. *C. fascicularis*

   Primary bracts glabrous and lacking subulate laminae .... 7. *C. monogyna*

4. Heads ovoid-conic, remaining almost closed; primary bracts glabrous .... 14. *C. drummondiana*

   Heads cylindric to broadly ovoid, gaping at anthesis; primary bracts strigose 5

5. Heads sessile among the basal leaves .... 13. *C. curta*

   Heads on leafless scapes 6

6. Primary bracts with arcuate linear laminae subequal to the bract bases .... 11. *C. pilosa*

   Primary bracts with straight mucros much shorter than the bract bases 7

7. Primary bracts broad-ovate, sheathing at the base, partly concealing the pseudanthia; temperate species flowering in spring .... 8. *C. strigosa*

   Primary bracts lanceolate, widely diverging and fully exposing the pseudanthia; tropical species flowering in winter .... 9. *C. exserta*

8. Secondary bracts several to numerous per head, hyaline at anthesis 9

   Secondary bracts absent (one brown, scarious vestigial concealed bract may be present in *C. polygyna*) 14

9. Leaves distichous; heads laterally compressed; primary bract laminae leaf-like 10

   Leaves never distichous; heads terete; primary bract laminae vestigial or absent 12

10. Heads sessile among the basal leaves .... 3. *C. inconspicua*

    Heads scapose 11

11. Heads more than 1.2 mm wide; scape two-edged for its full length .... 1. *C. aristata*

    Heads up to 1 mm wide; scape filiform-terete, becoming two-edged just below the head .... 2. *C. alepyroides*

12. Primary bracts acute; heads ovoid-conic, remaining almost closed .... 14. *C. drummondiana*

    Primary bracts obtuse; heads broadly ovoid, gaping at anthesis 13

13. Scapes subequal to the leaves; carpels 4-7 per pseudanthium .... 8. *C. strigosa*

    Scapes exceeding the leaves; carpels 7-20 per pseudanthium .... 10. *C. banksii*

14. Leaves distichous along elongated stems 15

    Leaves in a basal tuft, stems extremely condensed 16

15. Stigmatic papillae simple, 0.02 - 0.03 mm long .... 4. *C. muscoides*

    Stigmatic papillae branched, 0.05 - 0.1 mm long .... 5. *C. pedderensis*

16. Pseudanthia 4-10 per head (rarely 3 in a minority of heads) 17

    Pseudanthia never more than 3 per head 19

17. Margins of the primary bracts regularly ciliolate .... 15. *C. mutica*

Margins of the primary bracts entire 18

18. Leaf laminae straight, lax; lamina of outer primary bract capillary, shorter than the herbaceous base .... 6. *C. glabra*

Leaf laminae recurved, rigid; lamina of outer primary bract leaf-like, longer than the brown cartilaginous base .... 16. *C. eremica*

19. Heads ovoid-conic, at least half as wide as long, sessile; plant lacking dark pigment .... 19. *C. cephaloformis*

Heads ± cylindric, less than half as wide as long, scapose or sessile; leaves and/or bracts becoming dark-pigmented 20

20. Heads scapose (except in rare depauperate specimens); cataphyll obtuse; stamen adnate to gynophore .... 17. *C. polygyna*

Heads sessile among basal leaves; cataphyll acute; stamen free from gynophore 21

21. Heads laterally compressed; bract bases dark, indurated .... 18. *C. humillima*

Heads terete; bract bases scarious-hyaline .... 20. *C. caespitosa*

1. **Centrolepis aristata** (R. Br.) Roemer & Schultes, Syst. Nat. 1:44 (1817); Kunth, Enum. Pl. 3:490 (1841); J.D. Hook., Fl. Tasman. 2:76 (1858); Hieron., Abh. Naturf. Ges. Halle 12:213 (1873); F. Muell., Fragm. Phyt. Aust. 8:237 (1874); Benth., Fl. Austral. 7:206 (1878); Hieron., Pflanzenfam. 2(4):12 (1888); Bailey, Queensl. Fl. 6:1719 (1902); Rodway, Tasm. Fl. 232 (1903); Diels & Pritzel, Bot. Jahrb. Syst. 35:95 (1904); Ewart, Fl. Vict. 262 (1931); J.H. Willis, Handb. Pl. Vict. 1:278 (1962); Cooke in Jessop & Toelken, Fl. S. Aust. 4:1825 (1986).

Devauxia aristata R. Br., Prodr. 253 (1810), basionym; Nees in Lehm., Pl. Preiss. 2:71 (1846); Steudel, Syn. Pl. Glum. 2:267 (1855).

Type: Princeps Royal Harbour, Oyster Harbour, King Georges Sound [W.A.], xii.1801, *Brown* sub Bennett No.5828 (Lecto. here chosen: BM!; syn: CANB 67860!).

Centrolepis aristata var. *pygmaea* F. Muell ex Benth., Fl. Austral. 7:206 (1878).

Type: Swanport, Tas., *R. Story.* (Holo.: MEL 536053!).

sometimes tinged crimson-purplish at the base ...

Erect tufted annual 2-20 cm high, rigidly herbaceous, never purplish. *Roots* numerous, sparsely branched. *Stem* short, few-branched from the lower axils forming internodes less than 1 mm long. *Leaves* 3-6, distichous, equitant, near-basal, glabrous; sheath membranous, 3-8 mm long, passing into a keeled triquetrous lamina 10-75 mm long, 0.7-2 mm wide; apex acute, mucronate. Innermost 1 or 2 leaves with laminae reduced in length but never cataphyllous. *Scape* robust, 1-14 cm long, two-edged, glabrous or with scabridulous edges. *Head* laterally compressed, oblong, 1.3-4 mm wide. *Primary bracts* opposite, keeled, 3-veined, glabrous or with scabridulous keels, closely sheathing; outer bract with a brown cartilaginous sheath 3-5 mm long with hyaline margins terminating in minute obtuse lobes, passing abruptly into a lamina 8-45 mm long; inner bract similar but with a lamina 5-30 mm long. *Secondary bracts* 2 per pseudanthium, hyaline, 3-4 mm long, truncate and often erose; additional secondary bracts usually present between the pseudanthia. *Pseudanthia* 3-30, bisexual. *Stamen* free; filament capillary, 5-14 mm long; anther ellipsoid, 1-2 mm long. *Gynoecium* of 3-7 carpels; styles 1.8-3 mm long, connate at the base, pale brown; stigmatic papillae simple, c. 0.02 mm long. *Seed* fusiform, 0.6-0.8 mm long; testa smooth, stramineous. Fig. 2.

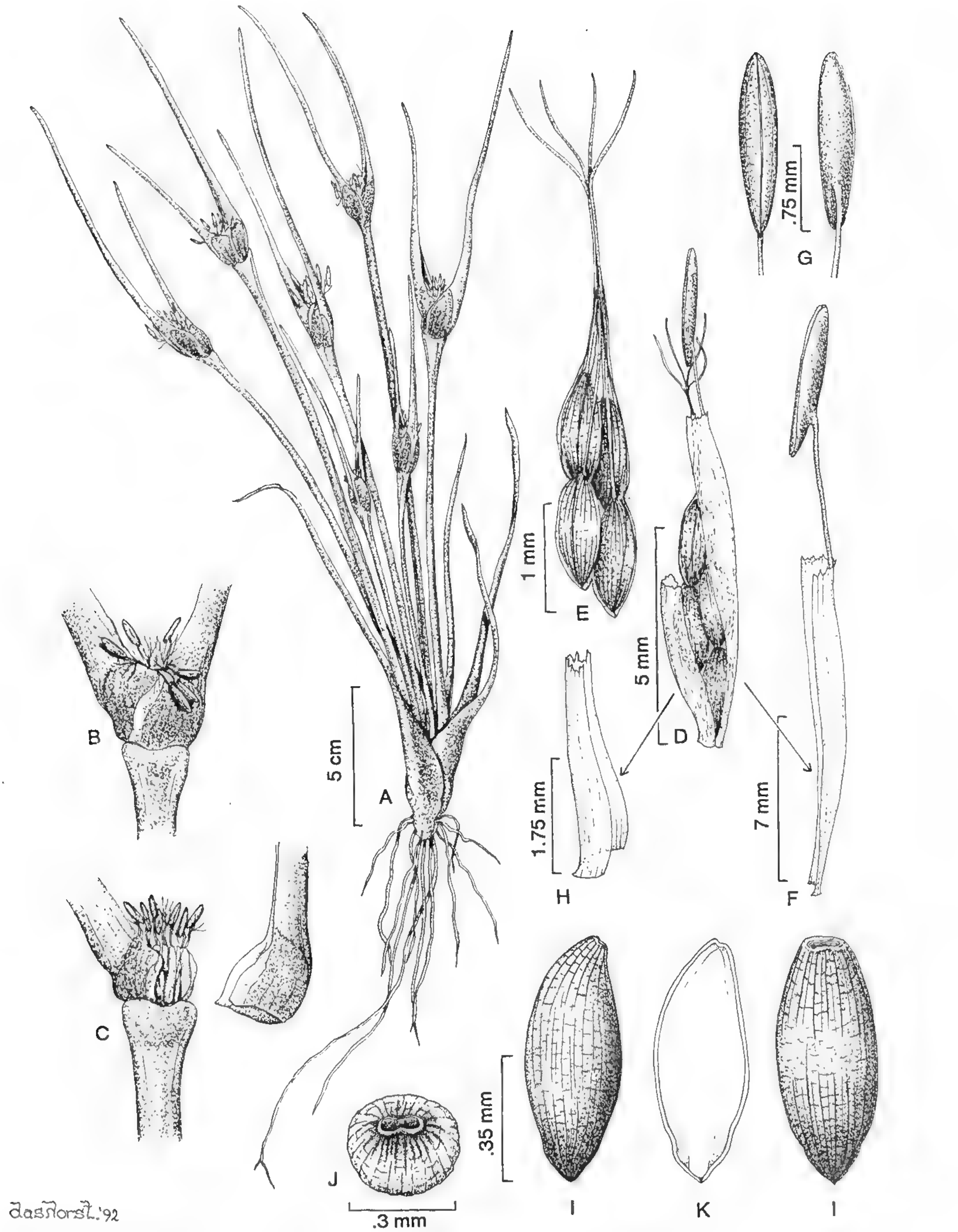
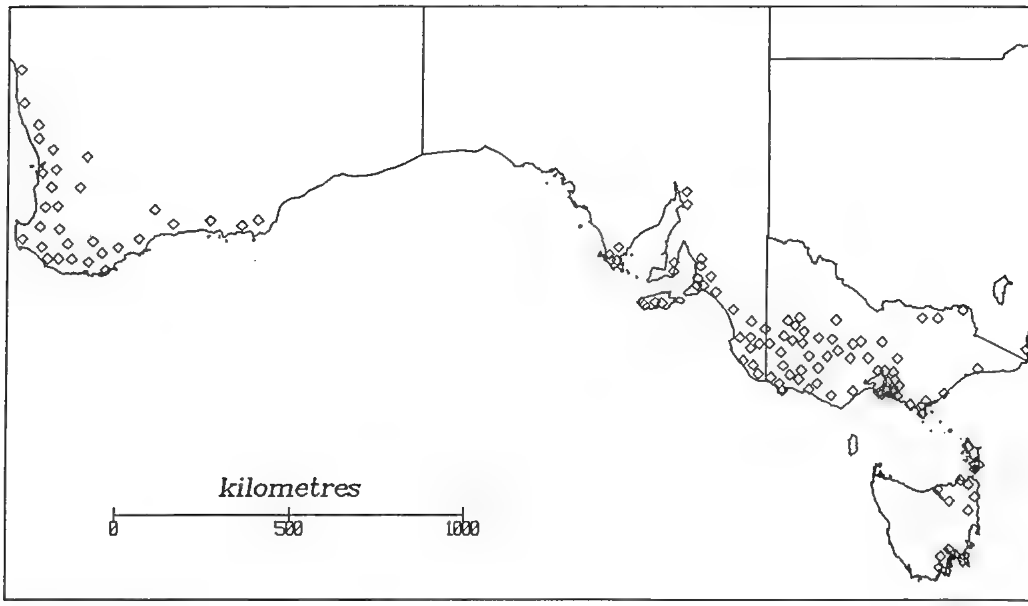


Fig. 2. *Centrolepis aristata.* A, habit; B, head; C, head with outer primary bract detached; D, pseudanthium with secondary bracts; E, gynoecium; F, stamen with secondary bract; G, anther, two views; H, secondary bract; I, seed, two lateral views; J, seed, viewed at micropylar end; K, seed, longitudinal section. (Based on *K. Stove 1834*: AD).

Distribution (Map 1)

Western Australia: widespread in the Avon and Darling botanical districts of Beard (1980) in the south-west. *South Australia*: widespread from southern Eyre Peninsula to the south-east of the State and the southern end of the Flinders Ranges. *New South Wales*: restricted to the extreme South Coast, where known from one record only. *Victoria*: widespread in the Western District and central Victoria south of the Dividing Range; scattered on the Gippsland coast. *Tasmania*: scattered in the north and east.



Map 1. Distribution of *Centrolepis aristata.*

Ecology

Winter annual of moist microhabitats within woodland, open forest, heath and mallee mainly on sandy soils, where often growing with other *Centrolepis* species such as *C. strigosa*. *Flowers* in September to November.

Notes

The BM sheet includes most of Brown's material with his annotations, and is here chosen as the lectotype.

The variety *pygmaea* was based on depauperate material that also appears to be immature, and is atypical only in its very short scapes. As a complete gradation exists between these specimens and those with normal scapes, I have not recognised the variety.

In the eastern States *C. aristata* never exceeds 10 cm tall, but specimens from Western Australia may reach 20 cm. Mueller applied the manuscript name var. *elata* to some of the latter specimens eg. Harvey River, *A. Oldfield* (MEL).

Selected specimens examined (total 215)

WESTERN AUSTRALIA: Mt Burdett, 4.x.1968, *Eichler 20134* (AD; PERTH); near Howick Hill, 18.ix.1962, *Eichler 19836* (AD); Pallarup Rocks, 13.x.1960, *George 1566* (PERTH); Yanchep National Park, 19.x.1965, *Scrymgeour 105* (PERTH); Helena Valley, 18.ix.1977, *Seabrook 226* (PERTH).

SOUTH AUSTRALIA: Manning Reserve, 17.x.1984, *Cooke 493* (AD); Comaum, 28.x.1962, *Hunt 1310* (AD); Marble Range, 4.x.1979, *Jackson 3682* (AD); Vivonne Bay, 22.x.1968, *Wheeler 1329* (AD); 5 miles E of Wanilla, 11.x.1958, *Whibley 345* (AD).

NEW SOUTH WALES: Eden, 24.x.1936, *Ising s.n.* (AD 966100764).

VICTORIA: Gorae West, xii.1943, *Beauglehole 254* (MEL); Arthurs Seat, 6.xii.1952, *Melville 2243* (MEL); Cosstick Reserve, 15.x.1960, *Muir 1471* (MEL); Chapple Vale, xi.1960, *Muir 1814* (MEL); Mount Morton, 26.x.1952, *Packe s.n.* (MELU).

TASMANIA: Piper Heads, 22.x.1960, *Burns 396* (HO); 7 km NW Gladstone, 24.xi.1974, *Chinnock 2215* (AD); Pittwater Causeway, 10.x.1966, *J.H. Hemsley 6018* (HO); Cape Barren Island, 20.xi.1969, *Whinray 424* (HO); Clarke Island, 16.xi.1979, *Whinray 1628* (AD).

2. **Centrolepis alepyroides** (Nees) Walp., Ann. Bot. 1:897 (1849); Hieron, Abh. Naturf. Ges. Halle 12:210 (1873); F. Muell. Fragm. Phyt. Aust. 8:237 (1874); Benth., Fl. Austral. 7:204 (1878); Blackall & Grieve, West. Aust. Wildfl. 1:59 (1954); Rye in Marchant et al., Fl. Perth Reg. 2:925 (1987).

Devauxia alepyroides Nees in Lehm., Pl. Preiss. 2:71 (1846), basionym; Steudel, Syn. Pl. Glum. 2:267 (1855).

Type: in arenosis aquaticis planitei ad radices jugi montani Darlings Range, Perth [W.A.], x.1839, *L. Preiss 1739* (Holo.: B, n.v.; iso.: MEL 536052!, MEL 1510141!). The holotype is annotated "Hb Nees".

Slender erect annual 1.5-6 cm high, softly herbaceous, becoming purplish after flowering. *Roots* few, the primary root persistent, unbranched. *Stem* usually unbranched. *Leaves* 2-4, near basal, distichous, glabrous; sheath membranous, 2-6 mm long, passing into a subterete keeled lamina 4-12 mm long, c. 0.4 mm wide; apex obtuse, often with a minute recurved mucro. Cataphyll absent. *Scape* filiform, 1-5 cm long, terete below, becoming two-edged just below the head, glabrous. *Head* laterally compressed, oblong, 0.6-1 mm wide. *Primary bracts* opposite, keeled, 3-veined, glabrous, closely sheathing; outer bract with a sheath 2.6-3.8 mm long, membranous with hyaline margins terminating in minute obtuse lobes, passing abruptly into a lamina 3.6-10 mm long; inner bract similar but with a lamina 1-4 mm long. *Secondary bracts* 2 per pseudanthium, acute, entire, hyaline. *Pseudanthia* 2-5, bisexual. *Stamen* free; filament capillary, 2.8-3.7 mm long; anther ellipsoid, c. 1 mm long. *Gynoecium* of 1-3 carpels; styles c. 2 mm long, connate for about half their length, dull pink; stigmatic papillae simple, c. 0.02 mm long. *Seed* fusiform, 0.6-0.7 mm long; testa smooth, stramineous. Fig. 3.

Distribution (Map 2)

Western Australia: scattered in the Avon and Darling botanical districts of the south-west.

A record for New South Wales (Bentham, 1878) was based on a misdetermination of a specimen of *C. polygyna* (Beckler, Hastings R.) now in MEL.

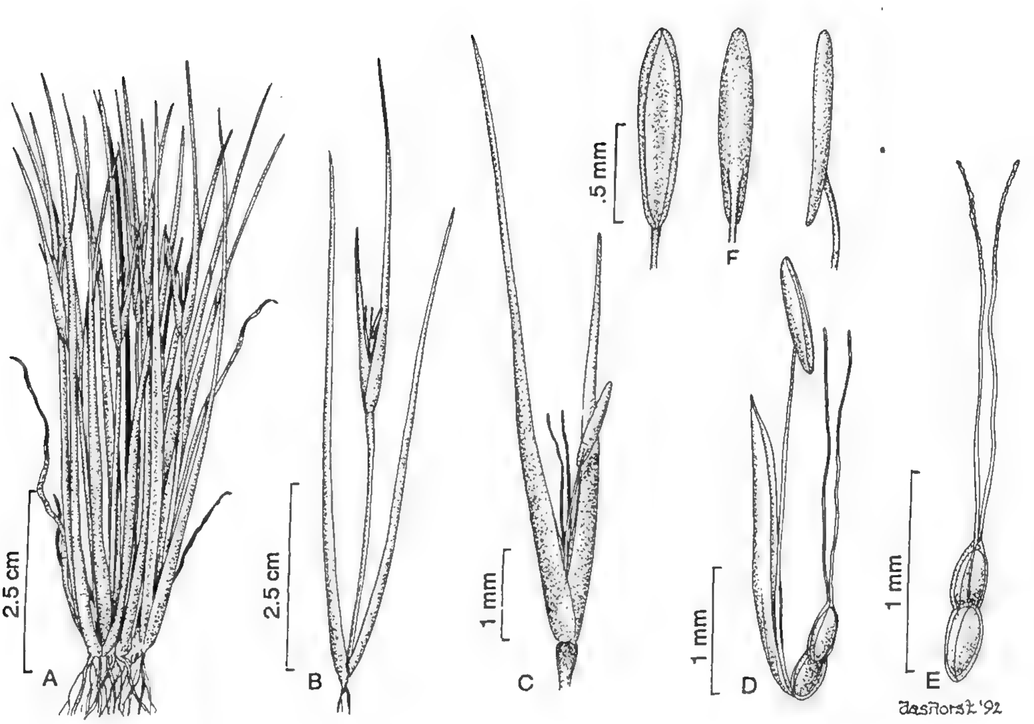


Fig. 3. *Centrolepis alepyroides*. A, habit; B, single plant; C, head; D, pseudanthium; E, gynoecium; F, anther, three views. (Based on *R.D. Spencer s.n.*: MEL 537442).

Ecology

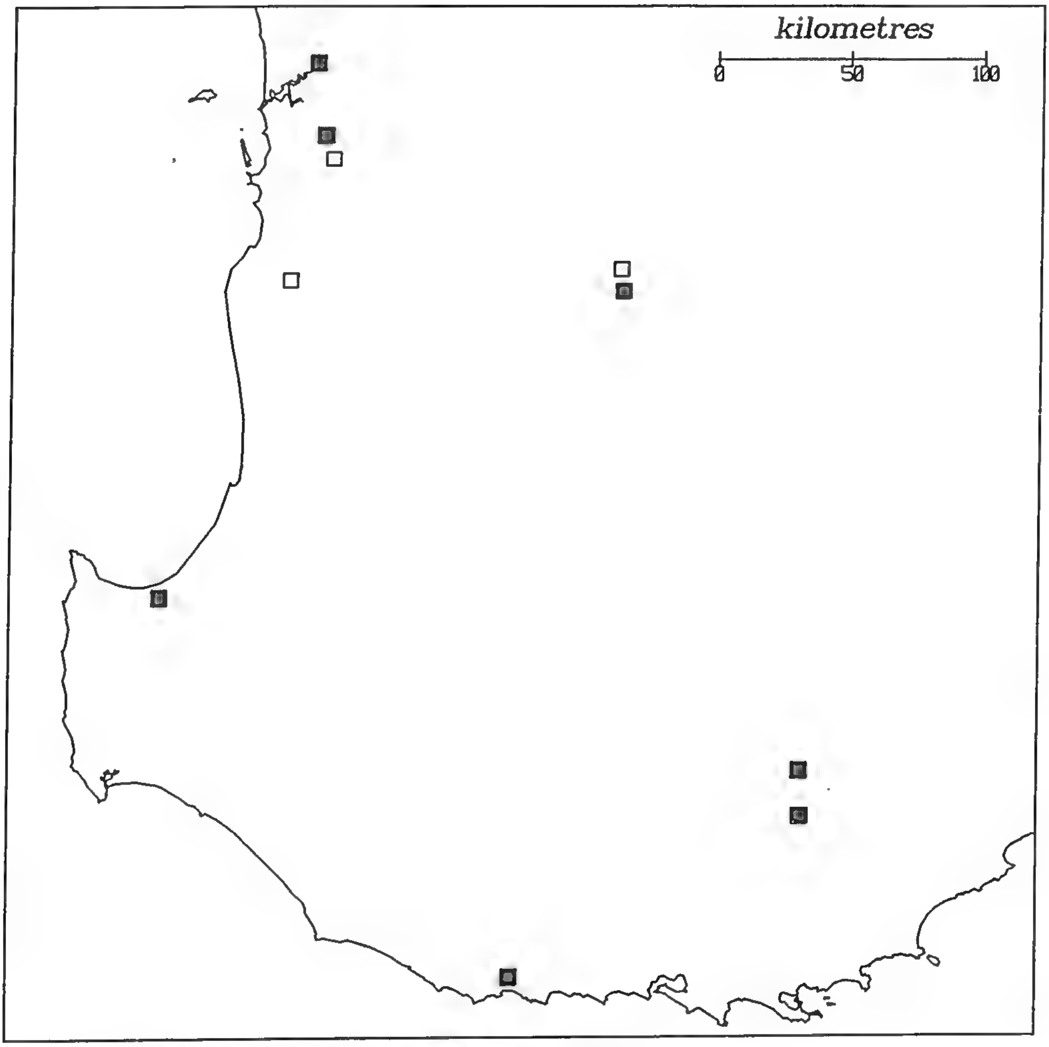
Short-lived winter annual restricted to moist habitats including moss beds and sandy margins of wetlands. *Flowers* in September to October.

Notes

C. alepyroides appears to be much rarer than *C. aristata* within the common range of these species. However, the low number of collections may also reflect the short life cycle implied by its small size, unbranched stem and persistent primary root. It is closely related to *C. aristata* but with a more gracile habit and reduced numbers of pseudanthia and carpels, suggesting a niche further from the ruderal strategy. In material examined, fewer than 15 seeds were produced per plant, implying a value of *r* remarkably low among annuals.

Specimens examined

WESTERN AUSTRALIA: north of Stirlings Range, x.1867, *Mueller s.n.* (MEL); Stirlings Range, x.1867, *Mueller s.n.* (MEL); Ambergate, 19.x.1948, *Royce 2900* (PERTH); Tutanning Reserve, 19.ix.1962, *Royce 7615* (PERTH); Guildford, 1894, *Sewell s.n.* (MEL); Walpole National Park, 7.x.1978, *Spencer 4* (MEL).



Map 2. Distribution of *Centrolepis alepyroides* ■ and *C. inconspicua* □.

3. **Centrolepis inconspicua** W.V. Fitzgerald, Proc. Linn. Soc. N.S.W. 28:107 (1903); Cooke, Muelleria 4:267 (1980); Rye in Marchant et al., Fl. Perth Reg. 2:927 (1987).

Type: Pinjarrah [W.A.], in wet spots, x.1900, *W. Fitzgerald s.n.* (Holo.: NSW 60350!).

Centrolepis basiflora C.H. Ostenfeld, Biol. Meddel. Kongel. Danske Vidensk. Selsk. 3(2):13 (1921).

Type: Armadale prope Perth [W.A.], 20.ix.1914, *Ostenfeld 11* (Holo.: C!; iso.:MEL 535280!; DBN, n.v.).

Minute tufted annual 0.5-2 cm high, rigidly herbaceous, never purplish. *Roots* few, the primary root persistent, sparsely branched. *Stem* unbranched; internodes of negligible length. *Leaves* 2-5, basal, distichous, equitant, erect, glabrous; sheath scarious, 3-4 mm long, passing into a keeled linear lamina 4-30 mm long, 0.5-1 mm wide; apex obtuse or produced into a hyaline mucro. Cataphyll absent. *Scape* absent. *Head* sessile, laterally

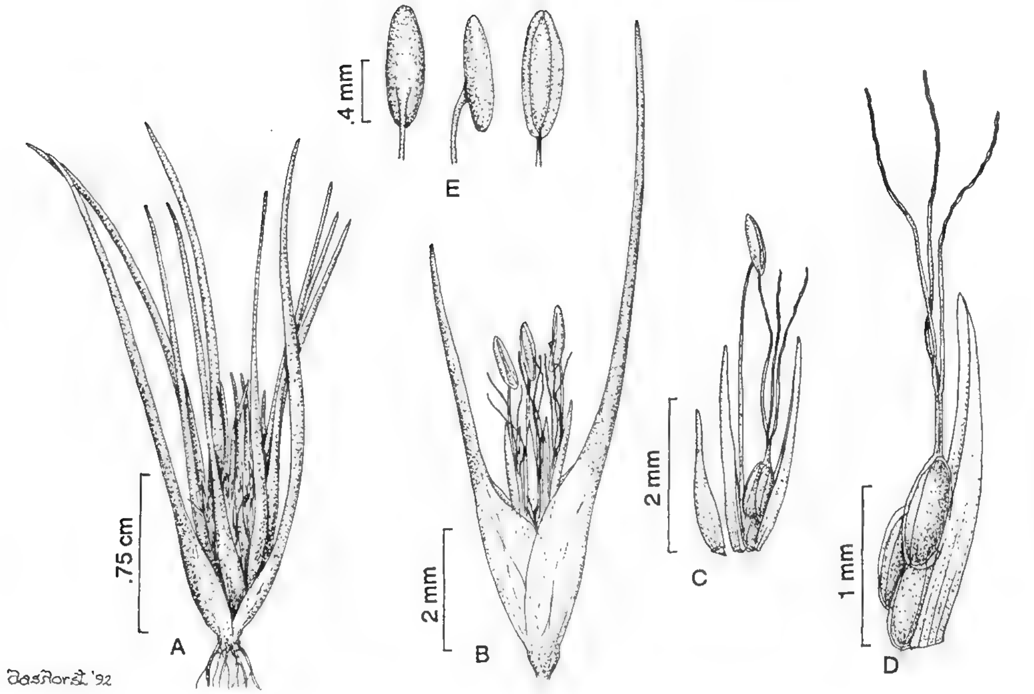


Fig. 4. *Centrolepis inconspicua.* A, habit; B, head; C, pseudanthium; D, gynoecium with second bract; E, anther, three views. (Based on *F. Mueller s.n.*: MEL 1502031).

compressed, oblong, 1-2 mm wide; rarely 1-3 additional heads sessile in the upper leaf axils. *Primary bracts* opposite, 3-veined, glabrous or the keels scabridulous with a row of antrorse papillae, gaping at anthesis; outer bract with a brown scarious sheath 1.5-3 mm long with hyaline margins ending in minute lobes, abruptly passing into a leaf-like lamina 4.5-13 mm long; inner bract similar with a lamina 3-10 mm long. *Secondary bracts* 2 per pseudanthium, hyaline, 2-3 mm long, acute and entire or minutely erose; additional shorter secondary bracts often present between the pseudanthia. *Pseudanthia* 2-5, bisexual. *Stamen* free; filament capillary, 2-4 mm long; anther ellipsoid, c. 0.8 mm long. *Gynoecium* of 1-4 carpels; styles c. 2 mm long, very shortly connate, pale brown; stigmatic papillae simple, c. 0.02 mm long. *Seed* fusiform, c. 0.5 mm long; testa smooth, stramineous. Fig. 4.

Distribution (Map 2)

Western Australia: scattered in the Avon and Darling botanical districts of the south-west between the 500 and 900 mm annual isohyets. Recorded from three localities only, but possibly more widespread and overlooked due to its size.

Ecology

Winter annual restricted to seasonally moist habitats including moss beds and sandy margins of wetlands. *Flowers* in September to October.

Specimens examined

WESTERN AUSTRALIA: Pinjarrah, x.1900, *W. Fitzgerald s.n.* (NSW); Armadale, 20.ix.1914, *Ostenfeld 11* (C; MEL); Tutanning Reserve, 18.x.1962, *Royce 7541* (PERTH); W.A., n.d., *n.coll.* (MEL 1502031).

4. **Centrolepis muscoides** (J.D. Hook.) Hieron., Abh. Naturf. Ges. Halle 12:209 (1873); Benth, Fl. Aust. 7:205 (1878); Rodway, Tasm. Fl. 231 (1903); W.M. Curtis, End. Fl. Tasm. 6:436 (1978).

Alepyrum muscoides J.D. Hook., Fl. Tasman. 2:77 (1858).

Type: Marlborough [Tas.], *R.C. Gunn s.n.* (Holo.: K; photo.!).

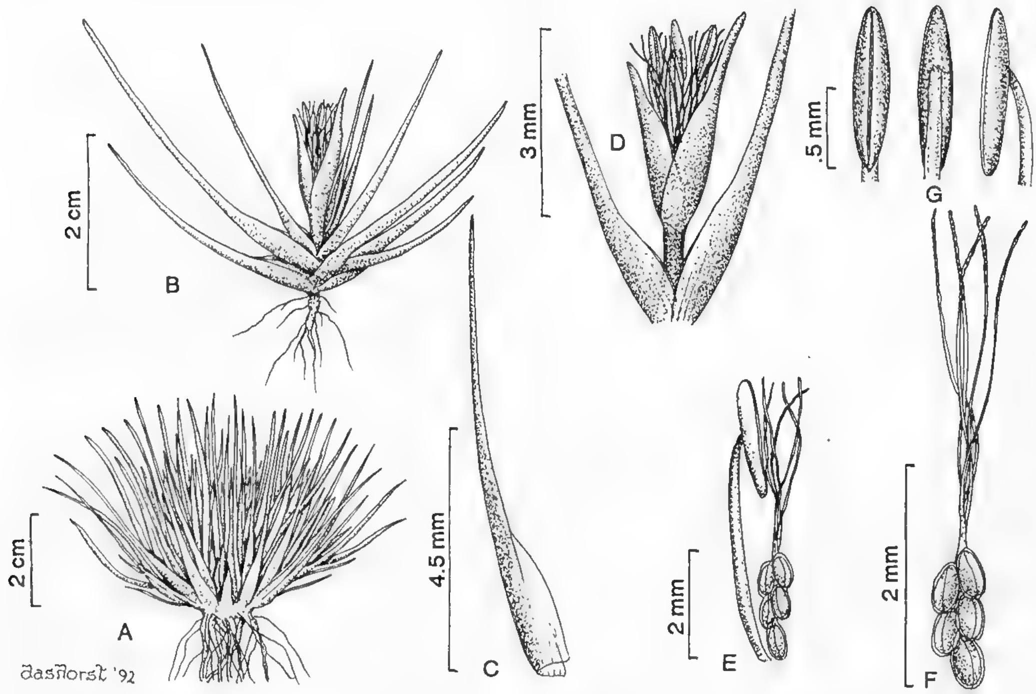


Fig. 5. *Centrolepis muscoides.* A, habit; B, branch; C, leaf; D, head with leaves; E, pseudanthium; F, gynoecium; G, anther, three views. (Based on *M.G. Noble 29074*: HO).

Loosely tufted annual 1-4 cm high, softly herbaceous, often becoming purplish. *Roots* adventitious, solitary at each node and emerging perpendicular to the leaf plane, usually unbranched, 2-5 cm long, robust. *Stem* erect, to 3 cm long, simple or sparsely branched. *Leaves* numerous, equitant, distichous, suberect in a fan-shaped cluster, glabrous; sheath 2-6 mm long, membranous with imbricate hyaline margins, passing abruptly into a subterete keeled lamina 2-9 mm long, 0.2-0.4 mm wide; apex subacute with a terminal hydathode. Uppermost 1 or 2 leaves reduced, cataphyll-like with lamina 1-2 mm long. *Scape* terete at the base, flattened distally, 1-2.5 cm long, glabrous. Heads terete, cylindric, c. 1 mm wide, gaping. *Primary bracts* opposite, rounded on the back, sheathing, 1-veined, glabrous; outer bract with a sheath 3-4 mm long with broad scarious margins, abruptly contracted into a subulate lamina c. 0.5 mm long; inner bract 2.7-3.7 mm long. *Secondary bracts* absent. *Pseudanthia* 2-5, 1-2 bisexual, the others lacking the stamen. *Stamen* free; filament 4-5 mm

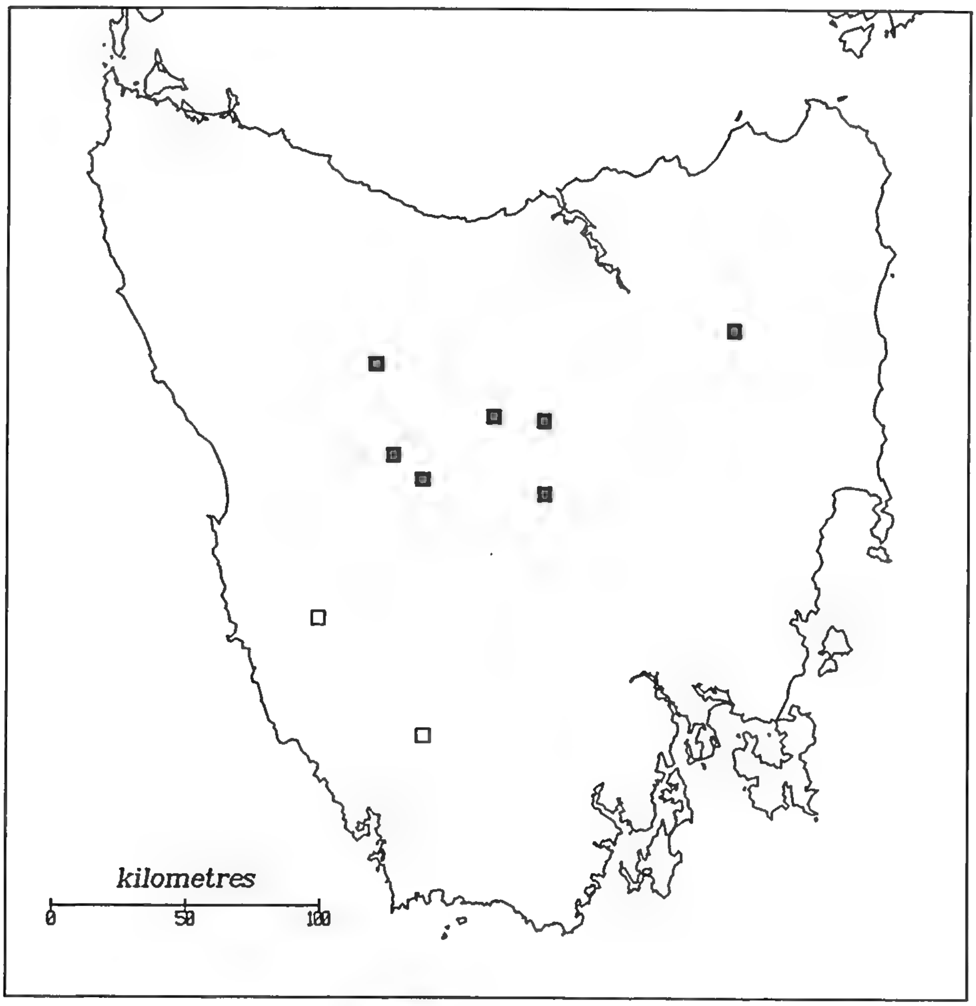
long, thickened below, reddish-mottled; anther ellipsoid, c. 1 mm long, purplish. *Gynoecium* of 5-8 carpels; styles 2-3 mm long, connate at the base only, deep pink; stigmatic papillae simple, 0.02-0.03 mm long. *Seed* fusiform, c.0.5 mm long; testa smooth, stramineous. Fig. 5.

Distribution (Map 3)

Tasmania: endemic to the Central Plateau and Ben Lomond, always above 600 m altitude.

Ecology

Summer annual, persisting as a perennial where covered by water during the winter, around the margins of lakes and streams on sandy alluvium with mosses. *Flowers* in January to April.



Map 3. Distribution of *Centrolepis muscoides* ▪ and *C. pedderensis* □.

Specimens examined

TASMANIA: no locality, no date, *Archer s.n.* (HO 23852); Dove Lake, Cradle Mountain Reserve, 4.ii.1961, *Burns s.n.* (HO); Lake Augusta, 4.iv.1971, *Curtis s.n.* (HO); Lake St.Clair, 1976, *Dobson s.n.* (HO); Lake Augusta, iii.1971, *Edwards s.n.* (HO); Lake Augusta, 4.iv.1971, *Edwards s.n.* (HO); Menamatta Tarns, 22.ii.1980, *M. Noble* 29074 (HO, MEL); Great Lake, ii.1894, *Rodway s.n.* (HO); Lake Marion, 15.i.1974, *Williams s.n.* (HO).

5. **Centrolepis pedderensis** W.M. Curtis, Brunonia 7:299 (1985).

Type: Tasmania, sandy shore of Lake Pedder (before flooding), 14.iii.1971, *P. Tyler s.n.* (Holo.: HO 49886!).

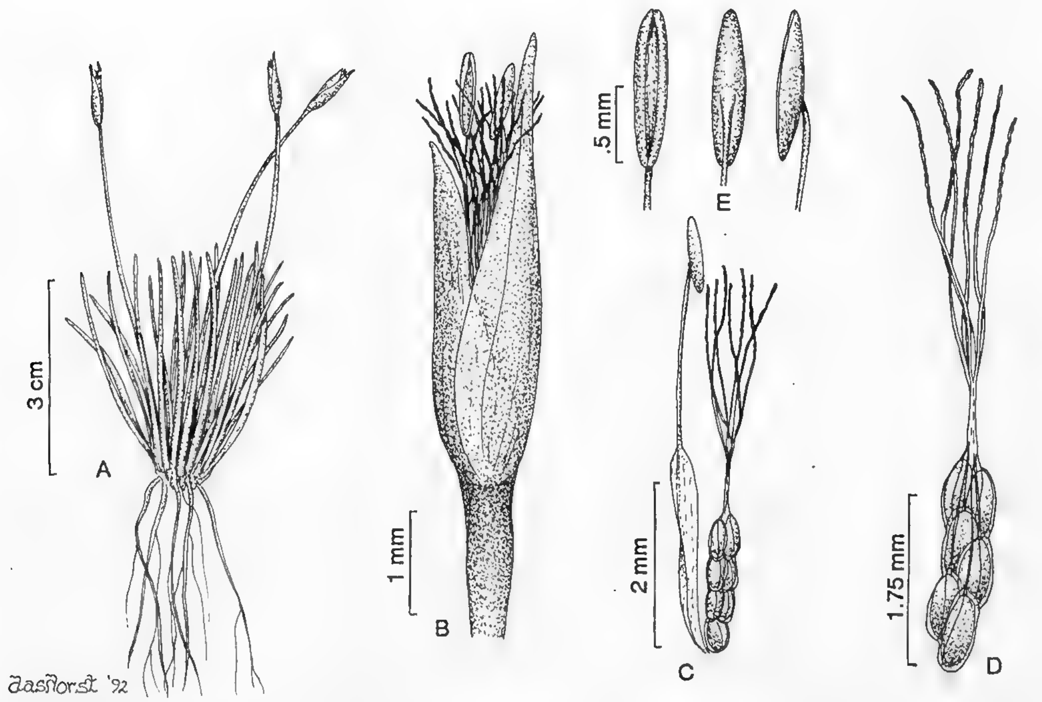


Fig. 6. *Centrolepis pedderensis.* A, habit; B, head; C, pseudanthium; D, gynoecium; E, anther, three views. (Based on *P.A. Tyler s.n.*: HO 49886).

Tufted annual or perennial 3-5 cm high, softly herbaceous, forming clumps to 7 cm diameter. *Roots* adventitious, solitary at each node and emerging perpendicular to the leaf plane, usually unbranched, 2-5 cm long, robust. *Stem* erect, to 4 cm long, simple or sparsely branched. *Leaves* numerous, equitant, distichous, suberect in a fan-shaped cluster, glabrous; sheath 3-10 mm long, membranous with imbricate hyaline margins, passing abruptly into a subterete keeled lamina 3-20 mm long, 0.3-0.8 mm wide; apex subacute with a terminal hydathode. Uppermost 1 or 2 leaves reduced, cataphyll-like with laminae 1-2 mm long. *Scape* terete at the base, flattened distally, 2-3.5 cm long, glabrous. *Head* terete, cylindric, c. 1 mm wide, gaping. *Primary bracts* opposite, rounded on the back, sheathing, 1-veined, glabrous; outer bract with a herbaceous sheath 3.5-4.5 mm long with broad scarious margins, abruptly contracted into a subulate lamina 0.5-1.2 mm long; inner bract elliptic, acute, 3.3-4.2 mm long, lacking a lamina. *Secondary bracts* absent. *Pseudanthia* 2-6, 1-2 bisexual, the others lacking the stamen. *Stamen* free; filament 4-5 mm long, thickened and compressed below, filiform near the apex, reddish; anther ellipsoid, 1-1.5 mm long,

purplish. *Gynoecium* of 3-7 carpels; styles 2.5-3.5 mm long, connate at the base only, deep pink; stigmatic papillae mostly trilobed, 0.05-0.1 mm long. *Seed* fusiform, c.0.5 mm long; testa smooth, stramineous. Fig. 6.

Distribution (Map 3)

Tasmania: along the Gordon River system and Lake Pedder, up to 300 m altitude.

Ecology

Summer-growing perennial, or a facultative annual in less favourable sites, on the sandy alluvium of streams and lake shores. *Flowers* in November to March.

Notes

A sibling species to *C. muscoides*, the range of these two species coinciding with two of the distinct centres of local endemism recognised by Kirkpatrick & Brown (1984).

C. pedderensis was a characteristic species of the quartz sand shore of the original Lake Pedder, where it formed large hummock-like clumps illustrated by Bayly et al. (1972) as *Centrolepis* sp. Although this habitat was destroyed in 1973, *C. pedderensis* persists along the Gordon River and may occur elsewhere in south-western Tasmania.

Specimens examined

TASMANIA: Gordon River Splits, 14.x.1977, *Crowden & Jarman s.n.* (HO); Lake Pedder, 24.i.1953, *Cruikshank s.n.* (HO); Lake Pedder, 25.i.1953, *Cruikshank s.n.* (MEL); Lake Pedder, 27.ii.1971, *Roper s.n.* (MEL); Lake Pedder, iii.1971, *Roper s.n.* (HO; MEL); Lake Pedder, 4.iii.1966, *Tyler s.n.* (HO; MEL); shore of Lake Pedder, 14.iii.1971, *P. Tyler s.n.* (HO).

6. **Centrolepis glabra** (F. Muell. ex Sonder) Hieron., Abh. Naturf. Ges. Halle 12:209 (1873); F. Muell., Fragm. Phyt. Aust. 8:237 (1874); Benth., Fl. Austral. 7:204 (1878); Tate, Handb. Fl. Extratrop. S. Aust. 178 (1890); Rodway, Tasm. Fl. 231 (1903); J. Black, Fl. S. Aust. 1:102 (1922); Ewart, Fl. Vict. 261 (1931); J.H.Willis, Handb. Pl. Vict. 1:279 (1962); Cooke in Jessop & Toelken, Fl. S. Aust. 4:1827 (1986); Rye in Marchant et al., Fl. Perth Reg. 2:926 (1987).

Devauxia glabra F. Muell. ex Sonder, Linnaea 28:226 (1856), ut 'Desvauxia', basionym.

Type: Mount Emu Creek [Vic.], *Mueller s.n.* (Holo.: MEL 536058!). Locality erroneously transcribed as "Mount Gumcreek" by Sonder.

Alepyrum muelleri J.D. Hook., Fl. Tasman. 2:78 (1858).

Type: Macquarie River [Tas.], *ex herb. R.C. Gunn s.n.* (Holo.: K photo.!).

Centrolepis platychlamys F.M. Reader, Victorian Nat. 23:23 (1906).

Type: Little Desert, Lowan [Vic.], xi.1900, *F. Reader s.n.* (Holo.: MEL!).

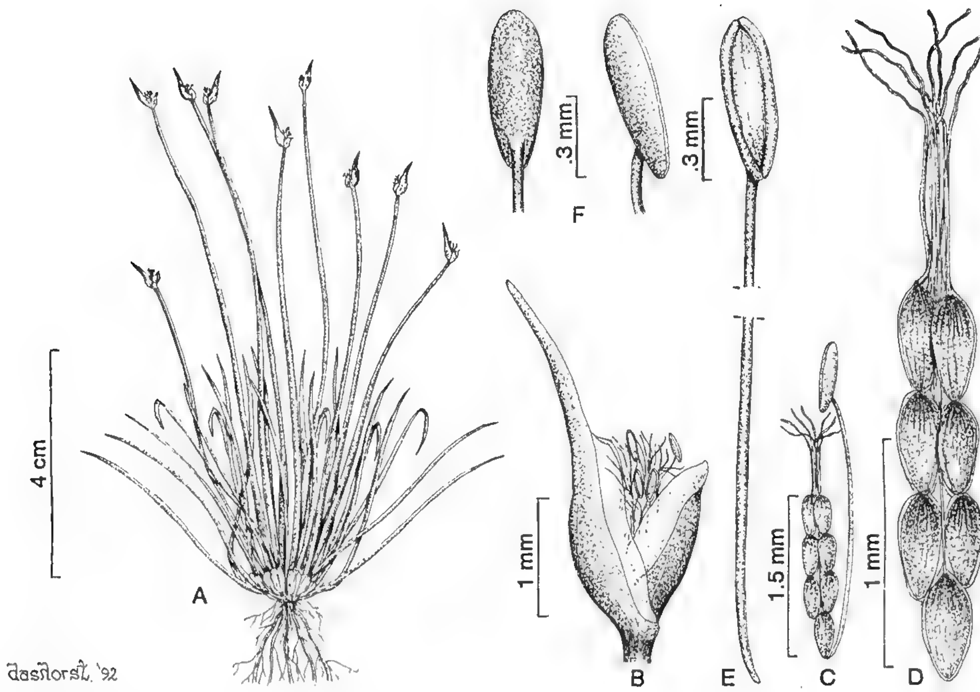
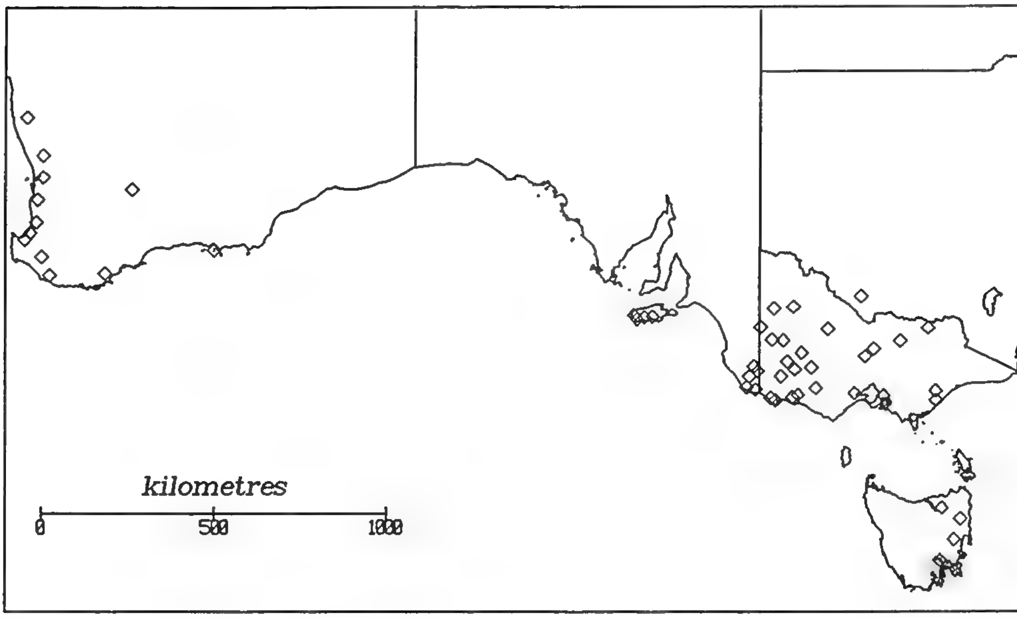


Fig. 7. *Centrolepis glabra*. A, habit; B, head; C, pseudanthium; D, gynoecium; E, stamen; F, anther, two views. (Based on *Hunt 2240*: AD).

Annual or ephemeral 1-8 cm high, softly herbaceous, sometimes becoming purplish. *Roots* numerous, sparsely branched. *Stem* few-branched; internodes of negligible length. *Leaves* few, basal, lax, glabrous; sheath 2-5 mm long, membranous with hyaline margins, passing into a flat linear straight lamina 8-75 mm long, 0.2-0.3 mm wide; apex acute, mucronate. Uppermost leaf reduced to an acute veinless hyaline cataphyll. *Scape* filiform, terete, 10-45 mm long, glabrous. *Head* terete, ovoid to cylindric, c. 1 mm wide. *Primary bracts* opposite, rounded on the back, closely sheathing, 1-veined, glabrous; outer bract with a herbaceous sheath 1.5-4 mm long with entire hyaline margins, abruptly contracted into a straight capillary lamina 0.8-2.5 mm long; inner bract 1.4-2.8 mm long, herbaceous with hyaline margins, acute, lacking a lamina or rarely mucronulate. *Secondary bracts* absent. *Pseudanthia* 3-7, bisexual or 1-2 lacking the stamen. *Stamen* free; filament capillary, 2-4 mm long; anther ovoid, 0.5-0.6 mm long. *Gynoecium* of 4-7 carpels; styles c. 1.5 mm long, connate at the base or rarely for up to 0.5 mm, pink to red; stigmatic papillae simple, c. 0.03 mm long. *Seed* ovoid, c. 0.4 mm long; testa smooth, stramineous. Fig. 7.

Distribution (Map 4)

Western Australia: scattered in the Avon and Darling botanical districts of the south-west. *South Australia*: restricted to Kangaroo Island and the lower South-East. *New South Wales*: restricted to the southern Riverina, where rare. *Victoria*: widespread in the Western District to about 36°N, extending to the Murray Valley; uncommon and localised on the coast. *Tasmania*: widespread at low altitudes.



Map 4. Distribution of *Centrolepis glabra.*

Ecology

A winter-growing annual with a specialised niche on bare mud around temporary water, and lacking the moisture conserving devices (hard texture or hairs) found in other annual species. It occurs on margins of streams and pools, sometimes associated with *Trithuria submersa* and *Aphelia gracilis* but never with other *Centrolepis* species. *Flowers* in September to December; very rarely found growing and flowering in autumn.

Notes

Plants vary greatly in the length of leaves and scapes, which are longest in specimens growing partly submerged. *C. platychlamys* was described from depauperate material with very short scapes, and was reduced to synonymy by Ewart et al. (1906).

Inflorescence characters are more constant, but some Western Australian material has relatively elongated heads with mucronulate inner primary bracts.

Selected specimens examined (total 78)

WESTERN AUSTRALIA: Midland Junction, 22.xi.1899, *Morrison s.n.* (PERTH); Yoonganillup, 16.x.1950, *Royce 3375* (PERTH); Middle Island, Recherche Archipelago, 22.xi.1950, *Willis s.n.* (MEL); 15 km N of Badgingarra, 2.xi.1965, *P. Wilson 3836* (PERTH); 0.5 km N of Brunswick Junction, 30.ix.1967, *P. Wilson 6254* (PERTH).

SOUTH AUSTRALIA: Comaum, i.1971, *K. Alcock 219* (AD); The Lorimer, Bool Lagoon, 27.xi.1964, *Hunt 2277* (AD); Kelly Hill, Kangaroo Island, 5.xi.1958, *P. Wilson 748* (AD).

NEW SOUTH WALES: Edward River, x.1875, *Mueller s.n.* (MEL).

VICTORIA: Mt Arapiles, 22.xi.1968, *Beauglehole 29750* (MEL); Black Range, 13.xii.1968, *Beauglehole 30062* (MEL); Winton, 14.x.1942, *R. Black s.n.* (MEL); Little Desert, 36°36'S 141°48'E, 4.xi.1978, *Cooke 232* (MEL); Tooley Reserve, 10.x.1982, *Spooner 8472* (AD).

TASMANIA: Epping, 22.xii.1955, *Curtis s.n.* (HO); Allwrights Lagoons, 1.xii.1990, *Moscal 20271* (AD).

7. **Centrolepis monogyna** (J.D. Hook.)Benth., Fl. Austral. 7:205 (1878);Rodway, Tasm. Fl. 232 (1903); W.M. Curtis, End. Fl. Tasm. 4:262 (1973).

Alepyrum monogynum J.D. Hook., Fl. Tasman. 2:77, t.138B (1858), basionym.

Type: [Tasmania], "1434", ex herb. *R.C. Gunn* (Holo.: K, photo.!).

Aphelia monogyna (J.D. Hook.) Hieron., Abh. Naturf. Ges. Halle 12:208 (1873).

Pseudalepyrum monogynum (J.D. Hook.)Dandy, J. Bot. (Lond.) 70:330 (1932).

Cushion-forming perennial 2-5 cm high, rigidly herbaceous, often purplish. *Stems* numerous, suberect, branching, with adventitious roots. *Leaves* numerous, crowded, obscurely distichous; sheaths imbricate, 4-6 mm long, scarious, stramineous to whitish, pilose with 2-many lax hairs, forming a minute ligule at the junction with subulate glabrous laminae 5-12 mm long, 0.2-0.4 mm wide; apex acute to obtuse, emucronate. Uppermost leaf reduced to an acute scarious 1-veined cataphyll c. 6 mm long. *Scape* terete, glabrous, to 1 cm long at anthesis, later accrescent to 1-2.5 cm long. *Head* slightly compressed, c. 2 mm wide. *Primary bracts* separated by an internode 0.7-1.2 mm long, closely sheathing, rounded on the back, herbaceous with subhyaline margins, 1-veined, glabrous, brown-tinted; outer bract with a sheath 3-4 mm long contracted into a foliar point 0.5-1.5 mm long; inner bract slightly shorter, acute or with a point to 1 mm long. *Secondary bracts* 1 per pseudanthium, 2-3 mm long, acute, entire, hyaline. *Pseudanthia* 2-6, all bisexual or a few lacking the stamen. *Stamen* free; filament capillary, 2.5-3 mm long; anther ellipsoid, 1-1.2 mm long. *Gynoecium* of 1-(2) carpels; styles deep pink; stigmatic papillae branched, c. 0.1 mm long. *Seed* ovoid, 0.7-0.9 mm long; testa smooth, stramineous.

Notes

C. monogyna is the Tasmanian representative of a complex which also includes *C. ciliata* (Hook.f.)Druce of New Zealand and *C. philippinensis* Merr. of Malesia and New Guinea. These entities differ mainly in the number of pseudanthia and carpels, ie. in the resources devoted to seed production as an adaptation to their differing habitats (Table 2). It is possible that a common ancestor of the complex was more widespread along the Great Dividing Range during the Pleistocene glacial periods of lowered treelines, and the relict populations have subsequently diverged.

The differences between the two Tasmanian taxa support their recognition at subspecies level only. Differences in leaf morphology between the type of subsp. *paludicola* and specimens of subsp. *monogyna* noted by Curtis (1985) were not found to be consistent throughout the whole range of specimens examined.

	Pseudanthia/head	**Carpels/pseudanthium**
C. ciliata (Edgar, 1960)	2-3-(4)	(1)-2
C. monogyna subsp. *monogyna*	2	1-(2)
C. monogyna subsp. *paludicola*	4-6	1
C. phillipinensis (Ding Hou, 1957)	2-4-(7)	2-4

Table 2. Parameters differentiating members of the *C. ciliata* complex

Key to subspecies

Pseudanthia 2 per head.......7a. subsp. *monogyna*
Pseudanthia 4-6 per head.......7b. subsp. *paludicola*

7a. subsp. **monogyna.**

Pseudanthia 2 per head, all bisexual. Carpels 1-(2) per pseudanthium.

Distribution (Map 5)

Tasmania: widespread in the south and west from near sea-level to 1100 m altitude, extending to Cradle Mountain and Lake St. Clair.

Ecology

Perennial in wet heath and alpine herbfield on poorly drained sands, gravels and peat. *Flowers* December to February.

Selected specimens examined (total 42)

TASMANIA: Lake St Clair, 19.i.1949, *S.T. Blake 18348* (HO); Lake Dobson, 22.i.1949, *N. Burbidge 3271* (HO); Port Davey, 12.ii.1971, *W. Curtis* (HO); Hartz Mountains, 12.xii.1968, *J. Hemsley 6535* (HO); Snug Plains, 28.i.1960, *W. Jackson* (HO 23894); Eldon Peak, 14.i.1981, *S. Jarman 95* (HO); Mt Counsel, 16.iii.1980, *A. Moscal 148* (HO); Lake Rhona, Denison Range, i.1977, *P. Tyler s.n.* (HO 31455); Mt Field National Park, 14.ii.1989, *N. Walsh 2299* (MEL).

7b. subsp. **paludicola** (W.M. Curtis) D.A. Cooke, comb. and stat. nov.

Centrolepis paludicola W.M. Curtis, Brunonia 7:298 (1985), basionym.

Type: Trappes Inlet, new Lake Pedder near Strathgordon, 28.i.1980, *D.I. Morris 8048* (Holo.: HO 33310!; iso.: MEL 1522861!; CANB, CHR, K, NSW n.v.).

Pseudanthia 4-6 per head, bisexual or some lacking the stamen. Carpel always solitary. Fig. 8.

Distribution (Map 5)

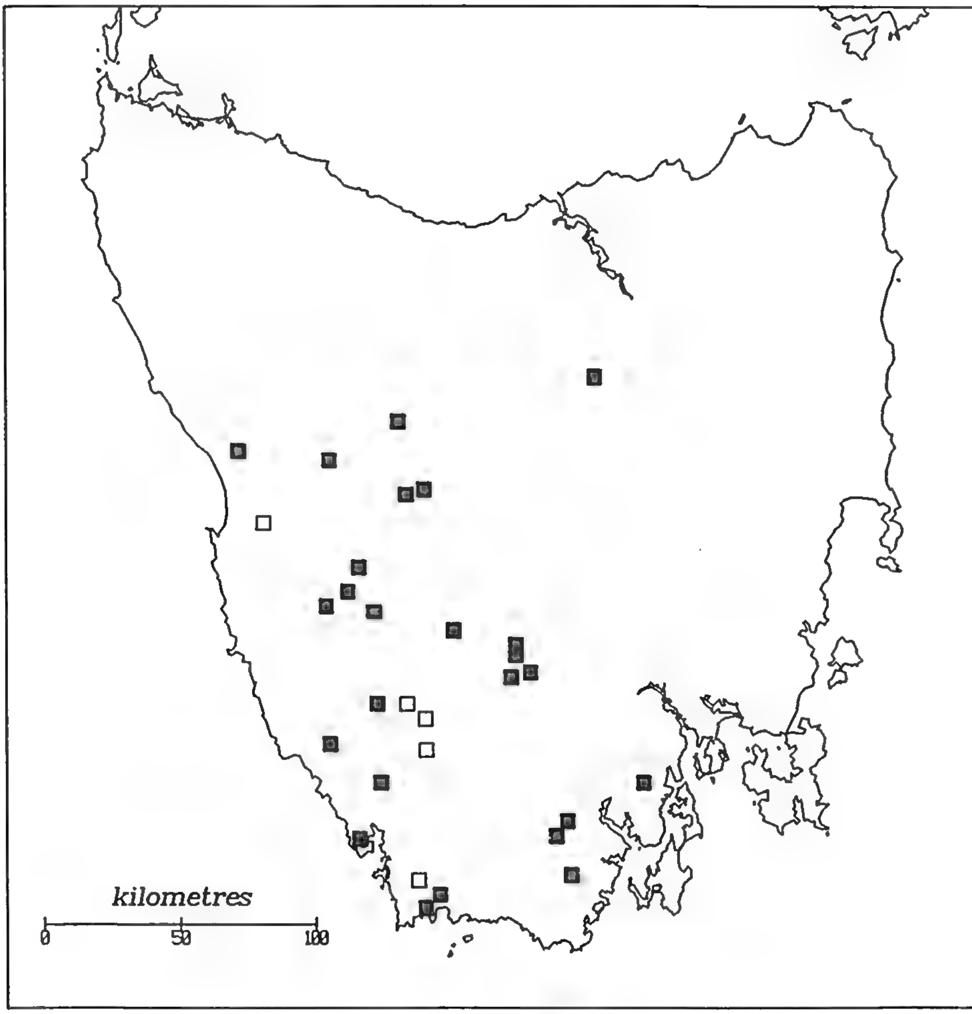
Tasmania: scattered in the south-west, from near sea-level to 350 m altitude.

Ecology

Perennial, in wet heaths on quartz sands and other alluvial soils. *Flowers* December to February.

Specimens examined (total 8)

TASMANIA: Melaleuca Inlet, Bathurst Harbour, 12.ii.1971, *W. Curtis* (HO 53789); McPartlan Pass, 42°51'S 146°10'E, 3.xii.1985, *W. Curtis* (HO; MEL); cultivated ex Lake Pedder, 1.xii.1972, *W. Curtis* (HO; MEL); Howard Plains, 20.i.1949, *L. Johnson s.n.* (HO); Trappes Inlet, Lake Pedder, 11.i.1980, *D. Morris 8018* (AD; HO); Lake Pedder, 27.ii.1971, *M. Roper* (MEL 527329); old Lake Pedder shore, 14.iii.1971, *P. Tyler* (AD 99127035).



Map 5. Distribution of *Centrolepis monogyna* subsp. *monogyna* ■ and subsp. *paludicola* □.

8. **Centrolepis strigosa** (R. Br.) Roemer & Schultes, Syst. Nat. 1:43 (1817); Kunth., Enum. Pl. 3:489 (1841); Hieron., Abh. Naturf. Ges. Halle 12:215 (1873); Benth., Fl. Austral. 7:207 (1878); Tate, Handb. Fl. Extratrop. S. Aust. 178 (1890); C. Moore, Handb. Fl. N.S.W. 442 (1893); Rodway, Tasm. Fl. 232 (1903); J. Black, Fl. S. Aust. 1:102 (1922); Ewart, Fl. Vict. 261 (1931); J.H. Willis, Handb. Pl. Vict. 1:279 (1962); N. Burb. & M. Gray, Fl. A.C.T. 92 (1970); N. Beadle et al., Fl. Sydney Reg. 591 (1972); Cooke in Jessop & Toelken, Fl. S. Aust. 4:1828 (1986).

Devauxia strigosa R. Br., Prodr. 252 (1810), basionym; Nees in Lehm., Pl. Preiss. 2:70 (1846); Steudel, Syn. Pl. Glum. 2:267 (1855).

Type: saxes prope Bald Head, King Georges Sound [W.A.], xii.1801, Brown sub Bennett No.5831 (Lecto. chosen here: BM!; syn.: CANB 67855!).

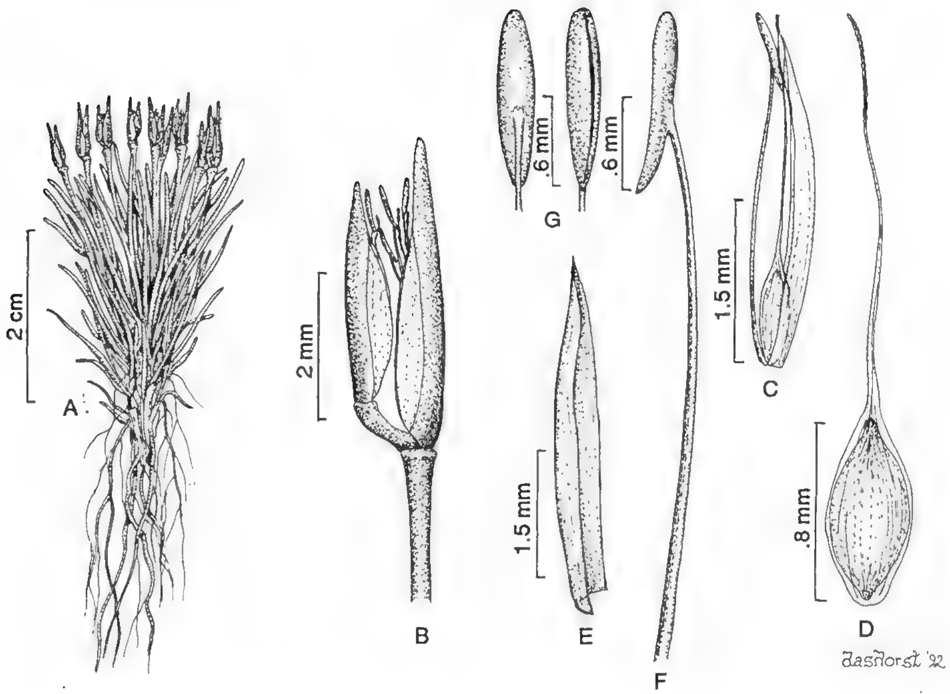


Fig. 8. *Centrolepis monogyna* subsp. *paludicola*. A, habit; B, head; C, pseudanthium with secondary bract; D, gynoecium; E, secondary bract; F, stamen; G, anther, two views. (Based on *D.J. Morris 8018*: AD).

Tufted annual 2-11 cm high, softly herbaceous, sometimes purplish after flowering. *Roots* numerous, branched. *Stem* repeatedly branching from the lower axils, forming internodes of negligible length. *Leaves* basal, very numerous, regularly radiating in a false spiral phyllotaxy throughout the tuft; sheath 2-8 mm long, membranous with hyaline margins, pilose, passing into a straight linear-subulate lamina 7-30 mm long, c. 0.4 mm wide, pilose with patent hairs or rarely glabrous; apex acute, mucronate. Uppermost leaf reduced to an obtuse glabrous veinless hyaline cataphyll 3-6 mm long. *Scape* terete, filiform, 1-10 cm long, glabrous or with fine lax hairs. *Head* terete, broadly ovoid, 2-4 mm wide. *Primary bracts* separated by an internode 1-2 mm long, rounded on the back, 3-5-veined, gaping at anthesis, similar; sheath broadly cymbiform, 2-3 mm long, herbaceous, strigose to glabrous with narrow hyaline margins, abruptly contracted into a glabrous mucro 0.5-1.3 mm long. *Secondary bracts* 2 per pseudanthium, hyaline, 2-2.5 mm long, obtuse to truncate, erose; additional secondary bracts present between pseudanthia. *Pseudanthia* 10-20, all bisexual. *Stamen* free; filament capillary, 2-5 mm long; anther ovoid, 0.5-1.1 mm long. *Gynoecium* of 4-8 carpels; styles c. 2 mm long, connate at the base, pale brown; stigmatic papillae simple, c. 0.03 mm long. *Seed* ovoid, c. 0.5 mm long; testa smooth, stramineous.

Key to subspecies

1. Anther completely exserted beyond the bracts; leaf lamina bearing 20-40 hairs per millimetre .... 8c. subsp. *rupestris*

Anther not exserted, partly concealed by the secondary bracts; leaf lamina bearing fewer than 16 hairs per millimetre .... 2.

2. Primary bracts both glabrous or bearing a few 2-5-celled hairs .... 8b. subsp. *pulvinata*

Primary bracts both strigose with numerous 4-8-celled hairs, or rarely one of the bracts subglabrous .... 8a. subsp. *strigosa*

8a. subsp. **strigosa**.

Devauxia patersonii R. Br., Prodr. 252 (1810); Steudel, Syn. Pl. Glum. 267 (1855).

Centrolepis patersonii (R. Br.) Roemer & Schultes, Syst. Nat. 1:43 (1817); Kunth., Enum. Pl. 489 (1841); Hieron., Abh. Naturf. Ges. Halle 12:214 (1873).

Centrolepis strigosa var. *patersonii* (R. Br.) Benth., Fl. Austral. 7:208 (1878).

Type: Port Jackson [N.S.W.], 1803, *Brown* sub Bennett No.5832 (Holo.: BM!).

Devauxia tenuior R. Br., Prodr. 252 (1810); Steudel, Syn. Pl. Glum. 267 (1855).

Centrolepis tenuior (R. Br.) Roemer & Schultes, Syst. Nat. 1:43 (1817); Kunth., Enum. Pl. 489 (1841); J.D. Hook., Fl. Tasman. 2:76 (1858); Hieron., Abh. Naturf. Ges. Halle 12:214 (1878).

Centrolepis strigosa var. *tenuior* (R. Br.) Benth., Fl. Austral. 7:208 (1878).

Type: Kings Island [Tas.], iv.1802, *Brown* sub Bennett No. 5830 (Lecto. chosen here: BM!; syn.: CANB 67854!, CANB 67856!, MEL 535281!, DBN n.v.).

Centrolepis aemula Rudge, Trans. Linn. Soc. London 10:284 (1811).

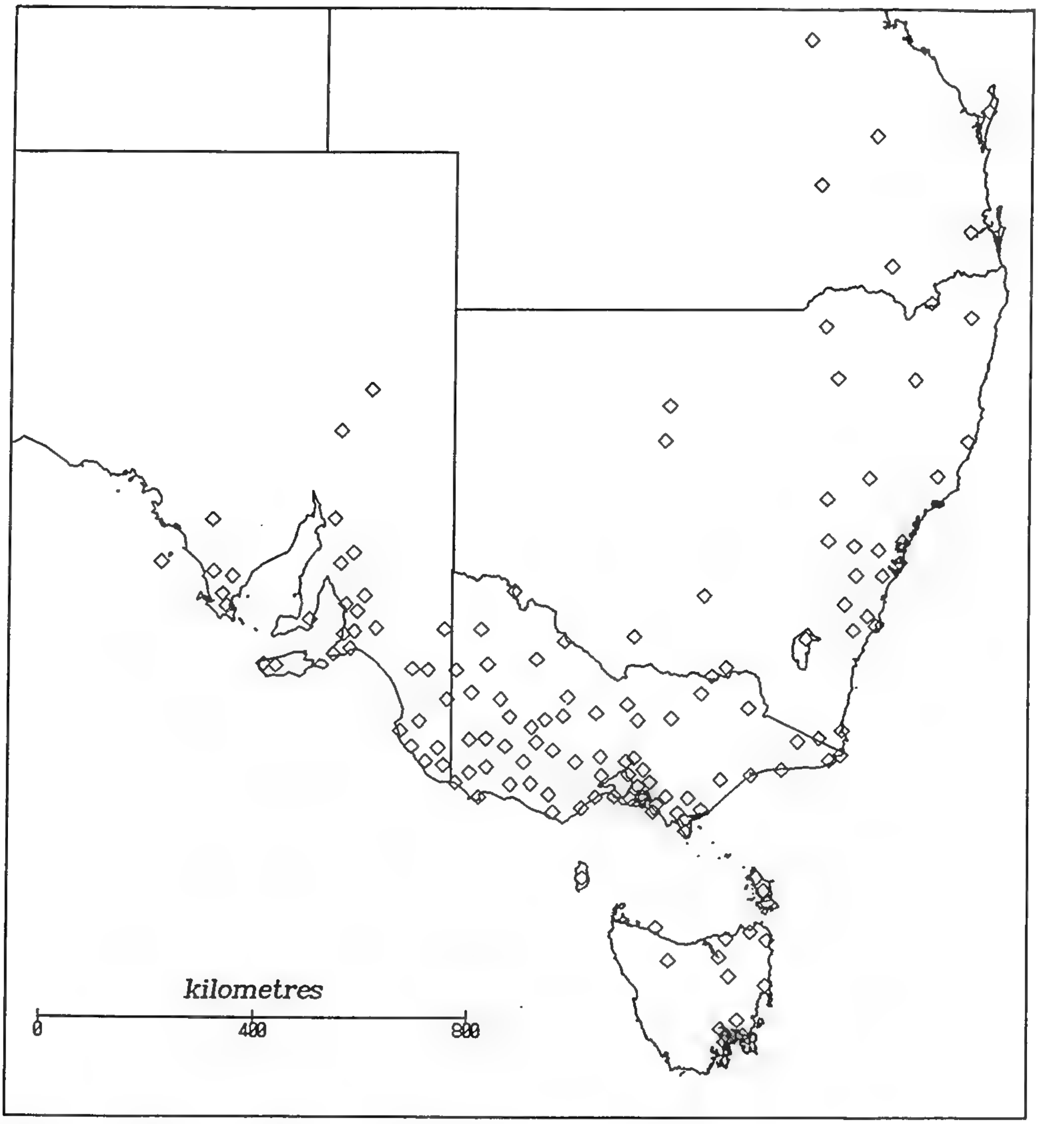
Type: fig.2, t.12 loc. cit.

Tufted herb to 11 cm high. *Leaf lamina* linear-subulate, 7-30 mm long, 0.2-0.5 mm wide, pilose with 3-15 weakly-spreading hairs per mm; apices tapering into mucros. *Scape* 1-10 cm long, glabrous or sparsely pubescent with lax crisped hairs, green to reddish. *Primary bracts* densely strigose with 5-8-celled hairs or the inner bract subglabrous; hyaline margins erose to erose-ciliate. *Filament* 2-3.5 mm long; anther 0.5-0.8 mm long, not exserted from head. Fig. 9.

Distribution (Map 6)

Western Australia: restricted to the south coast east of Albany. *South Australia*: widespread in near-coastal regions, extending to the Flinders Ranges and Murray mallee. *Queensland*: on the east coast and Dividing Range up to 20°S. *New South Wales*: widespread along the Coast, Tablelands and Western Slopes. *Victoria*: widespread throughout the State except in forests and the alps. *Tasmania*: Common in the north and east.

Also occurs as an adventive in the North Island of New Zealand (Healy & Edgar, 1980).



Map 6. Distribution of *Centrolepis strigosa* subsp. *strigosa* in eastern Australia.

Ecology

Winter annual occurring in heath, scrub, mallee, woodland and open forest on sand and infertile soils. *Flowers* September to November.

Notes

The BM sheet includes most of Brown's material with his annotations, and is here chosen as the lectotype.

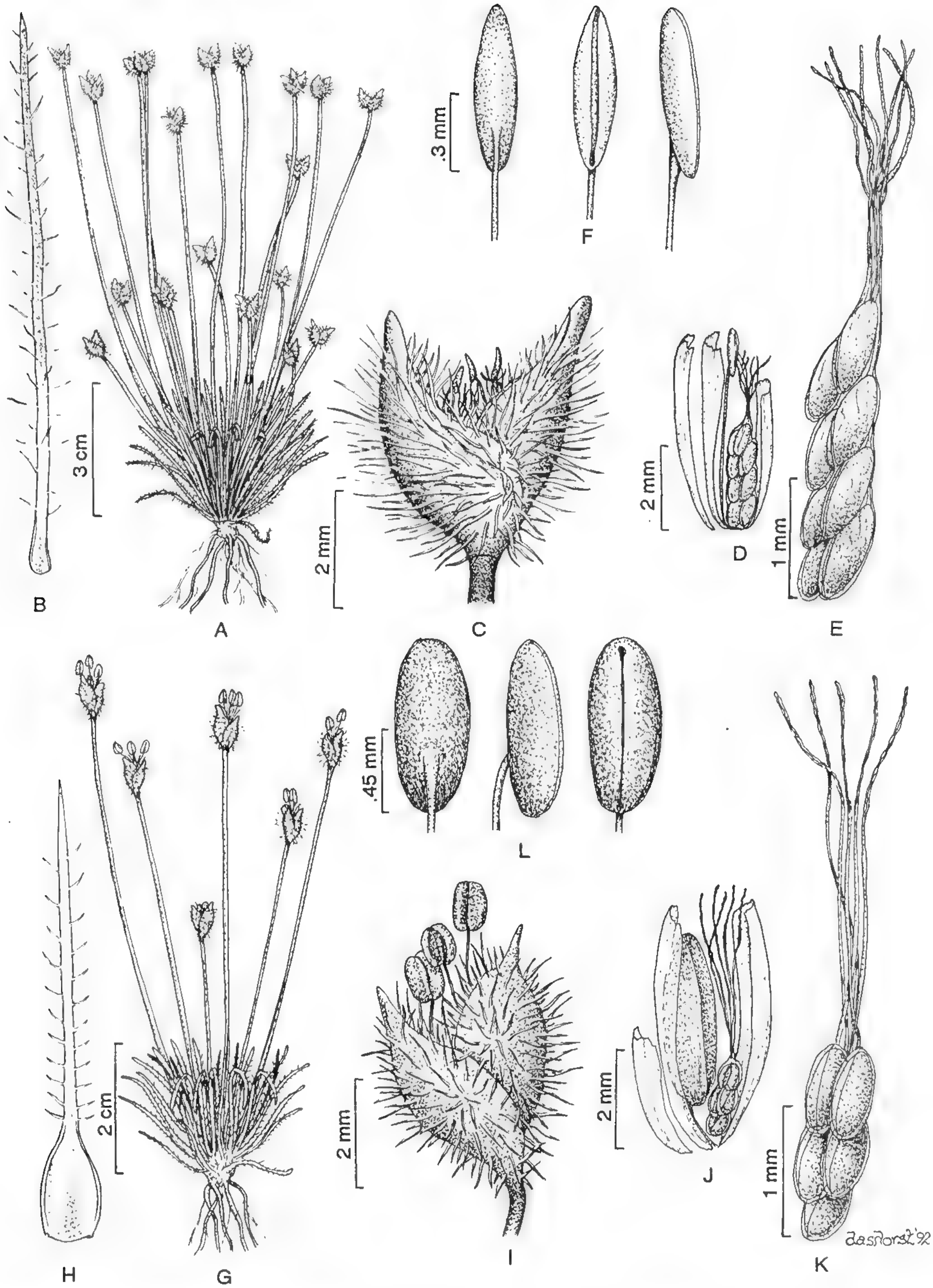


Fig 9. *Centrolepis strigosa* subsp. *strigosa*. A, habit; B, leaf; C, head; D, pseudanthium with secondary bracts; E, gynoecium; F, anther, three views. (Based on *A.G. Spooner 4766*: AD). — subsp. *rupestris*. G, habit; H, leaf; I, head; J, pseudanthium with secondary bracts; K, gynoecium; L, anther, three views. (Based on *P.G. Wilson 8751*: PERTH).

Notes cont.

C. tenuior was said to differ in its attenuate habit with scapes far exceeding the leaves, and *C. patersonii* in the glabrous or subglabrous inner primary bract. Plants with these characters developed to varying degrees are found throughout the range of subsp. *strigosa* intergrading completely with typical material, and there is no justification for reinstating these taxa even at varietal level.

Selected specimens examined (total 411)

WESTERN AUSTRALIA: Long Island, Recherche Archipelago, 11.xi.1950, *Willis s.n.* (MEL); Cape Le Grand, 6.x.1966, *Wilson 5549a* (PERTH).

SOUTH AUSTRALIA: Arcoona Creek, Gammon Ra., 16.ix.1956, *Eichler 12643* (AD); Aldinga Scrub, 13.x.1964, *Grivell s.n.* (AD); McLaren Flat, 30.x.1963, *Jackson 564* (AD); Wanilla Hills, 11.x.1958, *Whibley 2904* (AD).

QUEENSLAND: near Wallangarra, xi.1944, *Clemens s.n.* (BRI); Clayhole Creek 20 miles S of Yuleba, 9.xi.1958, *Johnson 677* (BRI); Fraser Island, i.1894, *Lovell s.n.* (BRI).

NEW SOUTH WALES: Bombah Point, Myall Lakes, 1.viii.1964, *Briggs s.n.* (NSW); Cobar, 1887, Curran 323 (MEL); Warrumbungle Range, x.1901, *Forsythe s.n.* (NSW); Crackerjack Rock W of Bathurst, 27.x.1963, *Ingram s.n.* (NSW); near Sassafras, 10.x.1950, *Johnson s.n.* (NSW).

VICTORIA: Lady Julia Percy Island, 22.x.1966, *Beauglehole 6643* (MEL); Little Desert National Park, 2.xi.1978, *Cooke 201* (MEL); Mt Sisters near Omeo Plains at 3600', n.d., *Stirling 115* (MEL); Quail Island, 22.xi.1952, *Willis s.n.* (MEL).

TASMANIA: Pittwater Causeway, 10.xii.1966, *Hemsley 6019* (NSW); Blackmans Bay, 16.xi.1930, *Rodway s.n.* (HO); Launceston, xii.1879, *Simson 1670* (MEL); Cape Barren Island, 22.x.1973, *Whinray 551* (MEL).

EXTRA-AUSTRALIAN: New Zealand: The Bluff, i.1890, *T. Kirk s.n.* (MEL).

8b. subsp. **pulvinata** (R. Br.) D.A. Cooke, comb. & stat. nov.

Devauxia pulvinata R. Br., Prodr. 252 (1810), basionym; Steudel, Syn. Pl. Glum. 2:267 (1855).

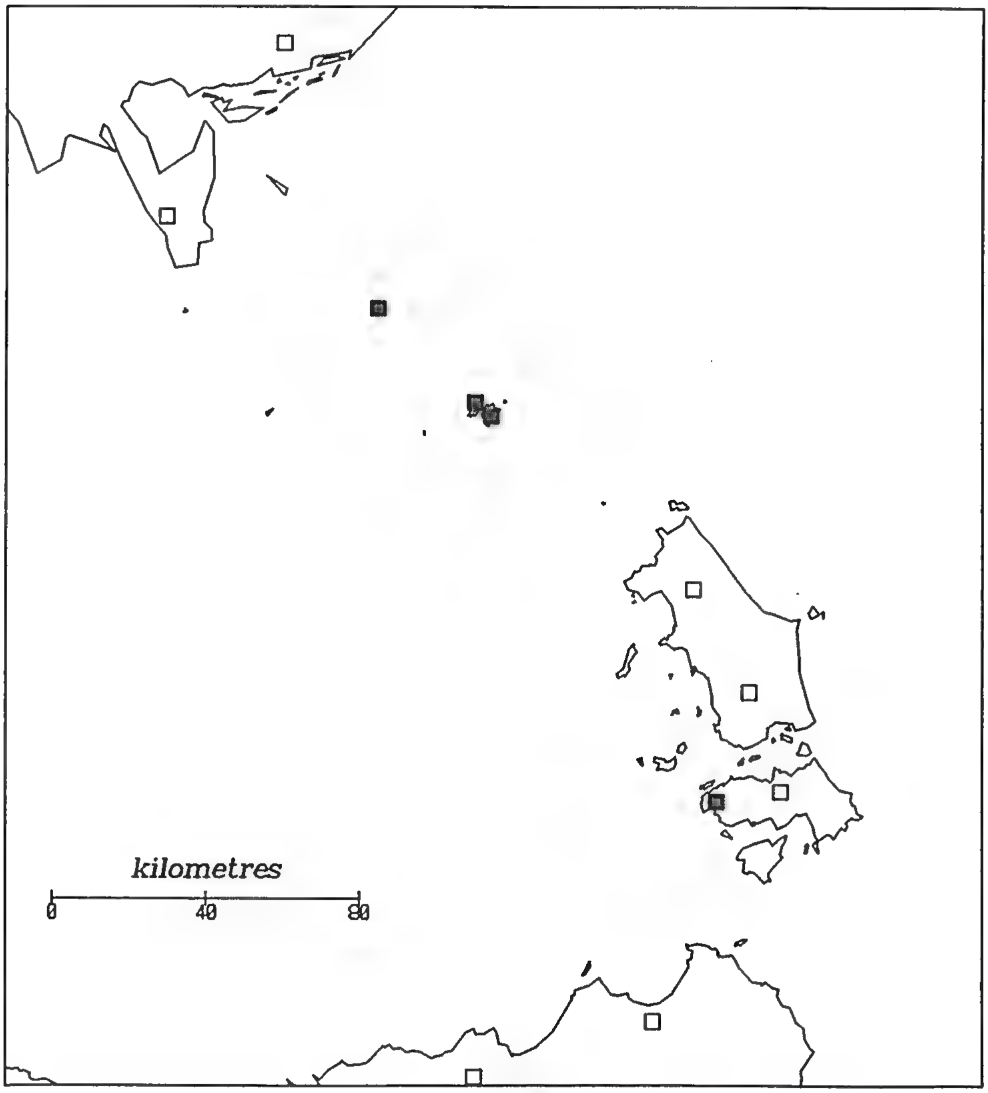
Type: Freestone Bay, Kents Group [Tas.], 19.xii.1803, *Brown* sub Bennett No. 5833 (Lecto. chosen here: BM!; syn.: CANB 67859!).

Centrolepis pulvinata (R. Br.) Roemer & Schultes, Syst. Nat. 1:43 (1817); Desv., Ann. Sci. Nat.(Paris) 13:42 (1828); Kunth, Enum. Pl. 3:489 (1841); J.D. Hook., Fl. Tasman. 2:77 (1858); Hieron., Abh. Naturf. Ges. Halle 12:214 (1873); Benth., Fl. Austral. 7:205 (1878); Rodway, Tasm. Fl. 232 (1903); W.M. Curtis, End. Fl. Tasm. 4:262 (1973).

Densely tufted herb to 4 cm high forming compact hemispherical cushions. *Leaf lamina* dorsiventrally compressed, linear-subulate, 6-18 mm long, 0.3-0.5 mm wide, glabrous or with 1-6 lax hairs per mm; apices tapering into mucros. *Scape* 0.8-3 cm long, usually subequal to the leaves, glabrous, green. *Primary bracts* glabrous or the outer bract with a few 2-5-celled hairs; hyaline margins ciliolate to subentire. *Filaments* 2-3 mm long; anther c. 0.6 mm long, not exserted from head.

Distribution (Map 7)

Tasmania: restricted to the islands of eastern Bass Strait, where recorded from Hogan Island, the Kent Group and Cape Barren Island of the Furneaux Group and sympatric with subsp. *strigosa*. A record from the Tasmanian mainland (Brown et al., 1983) is referable to subsp. *strigosa*.



Map 7. Distribution of *Centrolepis strigosa* subsp. *pulvinata* ■ and subsp. *strigosa* □ in Bass Strait.

Ecology

Winter annual in low open coastal vegetation. *Flowers* in July to October.

Notes

The BM sheet includes most of Brown's material with his annotations, and is here chosen as the lectotype.

The type of *C. pulvinata* represents an extreme population on Deal Island with completely glabrous leaves and bracts, and scapes no longer than the leaves. Other collections form a cline towards subsp. *strigosa*, having a similar habit and sparsely hairy leaves and bracts. Some material of subsp. *strigosa* from the north coast of Tasmania also shows some approach to this subspecies in its compact habit and reduced vestiture. Therefore, *C. pulvinata* is here treated as a subspecies of *C. strigosa*.

Conservation status

Like many other ruderals, it has not been adversely affected by habitat disturbance, and was reported as common along road verge drains on Deal Island (Whinray, 1971). A risk code of 2RC (rare but not threatened, and represented in reserves) applies.

Selected specimens examined (total 15)

TASMANIA: Hogan Island, i.1968, *Scarlett s.n.* (MEL); Cape Barren Island, 3.xi.1973, *Whinray 223* (AD); Erith Island, 12.xii.1970, *Whinray 384* (HO); Deal Island, Kent Group, 29.xii.1968, *Whinray 228* (HO); 26.xi.1970, *Whinray 1883* (MEL); 29.xi.1970, *Whinray s.n.* (MEL 526249); Freestone Bay, Deal Island, 8.vii.1971, *Whinray 1940A* (MEL).

8c. subsp. **rupestris** D.Cooke, subsp. nov.

Herba dense caespitosa usque ad 4 cm alta. *Laminae foliorum* omnino teretae, 7-11 mm longae, 0.2-0.3 mm latae, densissime strigosae pilibus rigidis patentibus 20-40 in quoque milimetro; apices in mucronibus abrupte contracti. *Scapus* 1.5-3.5 cm longus, glaber, nitens, rubescens. *Bracteae primariae* ambae dense strigosae pilis 5-8-cellularibus, marginibus hyalinis eroso-ciliatis. *Staminis* filamentum 3.5-5 mm longum, antheram trans apices bractearum primariarum ferentum. Anthera 0.8-1.1 mm longa. (Descriptio typi).

Type: Hickey Ricken Soak, 60 km N of Bullfinch, W.A., 24.viii.1970, *P.G. Wilson 8751* (Holo.: PERTH!; iso.: MEL 1517607!).

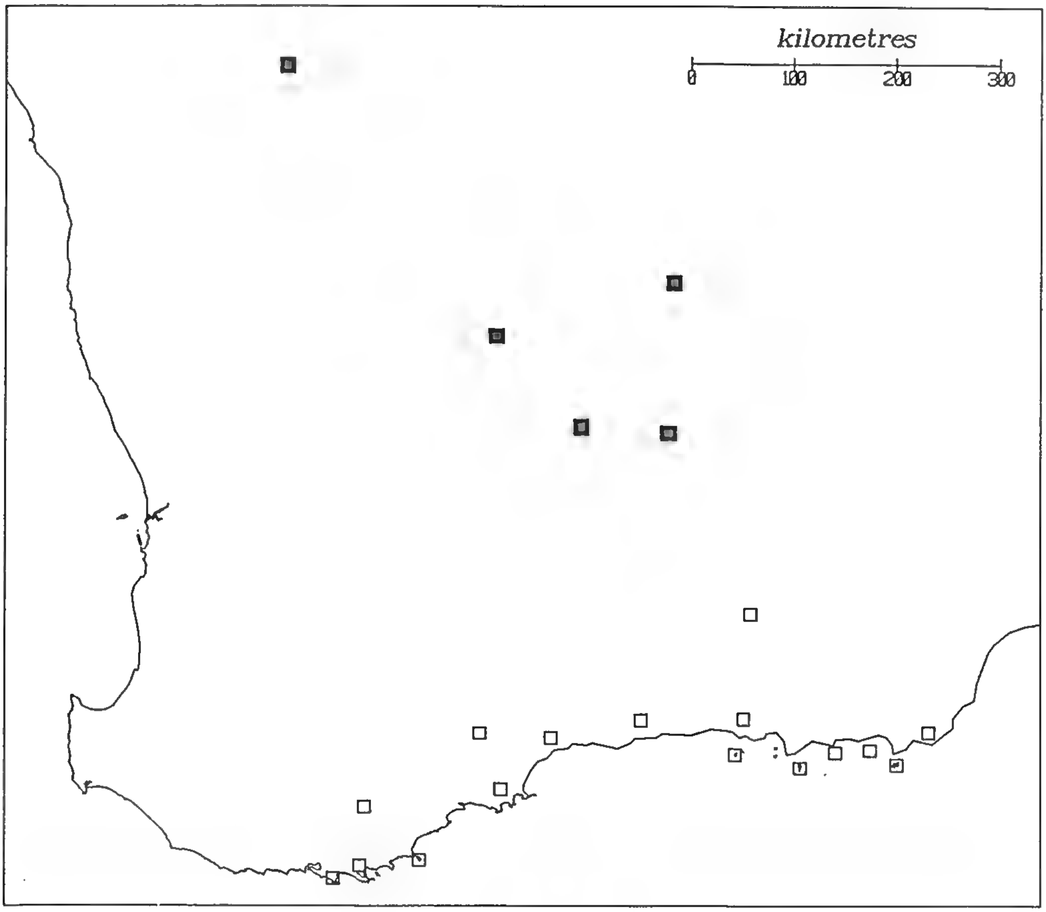
Densely tufted herb to 4 cm high. *Leaf lamina* quite terete, 7-11 mm long, 0.2-0.3 mm wide, very densely strigose with 20-40 rigidly spreading hairs per mm; apices abruptly contracted into mucros. *Scape* 1.5-3.5 cm long, glabrous, shiny, becoming reddish. *Primary bracts* both densely strigose with 5-8-celled hairs; hyaline margins erose-ciliate. *Filament* 3.5-5 mm long, bearing the anther beyond the apices of the primary bracts; anther 0.8-1.1 mm long. Fig. 9.

Distribution (Map 8)

Western Australia: restricted to the Austin and Coolgardie botanical districts in the Eremaean province around the 250 mm annual isohyet.

Ecology

Winter annual confined to moist microhabitats receiving runoff water, mainly around granite outcrops. *Flowers* in August to October.



Map 8. Distribution of *Centrolepis strigosa* subsp. *rupestris* ■ and subsp. *strigosa* □ in Western Australia.

Notes

Apparently parapatric with the more coastal subsp. *strigosa.*

Specimens examined

WESTERN AUSTRALIA: Woodline, n.d., *Cleland s.n.* (AD); 298 mile peg [479 km], Great Eastern Highway, 18.ix.1962, *George 4176* (PERTH); 29 miles [47 km] W of Mt Magnet, 11.ix.1966, *George 7964* (PERTH); Queen Victoria Rock, 8.xi.1976, *Wittwer 1933* (PERTH).

9. **Centrolepis exserta** (R. Br.) Roemer & Schultes, Syst. Nat. 1:44 (1817); Hieron., Abh. Naturf. Ges. Halle 12:215 (1873); F. Muell., Fragm. Phyt. Aust. 8:237 (1874); Benth., Fl. Austral. 7:208 (1878); Bailey, Queensl. Fl. 6:1720 (1902); Ewart & O.Davies, Fl. Northern Territory 66 (1917).

Devauxia exserta R. Br., Prodr. 253 (1810), basionym; Steudel, Syn. Pl. Glum. 2:267 (1855).

Type: East coast of New Holland, particular place forgotten [Qld], 1802, *Brown* sub Bennett No. 5827 (Holo.: BM!).

Centrolepis exserta var. *rubra* Bailey, Queensl. Fl. 6:1720 (1902); Compr. Cat. Queensl. Pl. 584, fig. 567 (1913).

Type: Fraser Island [Qld], *Lovell s.n.* (Holo.: BRI).

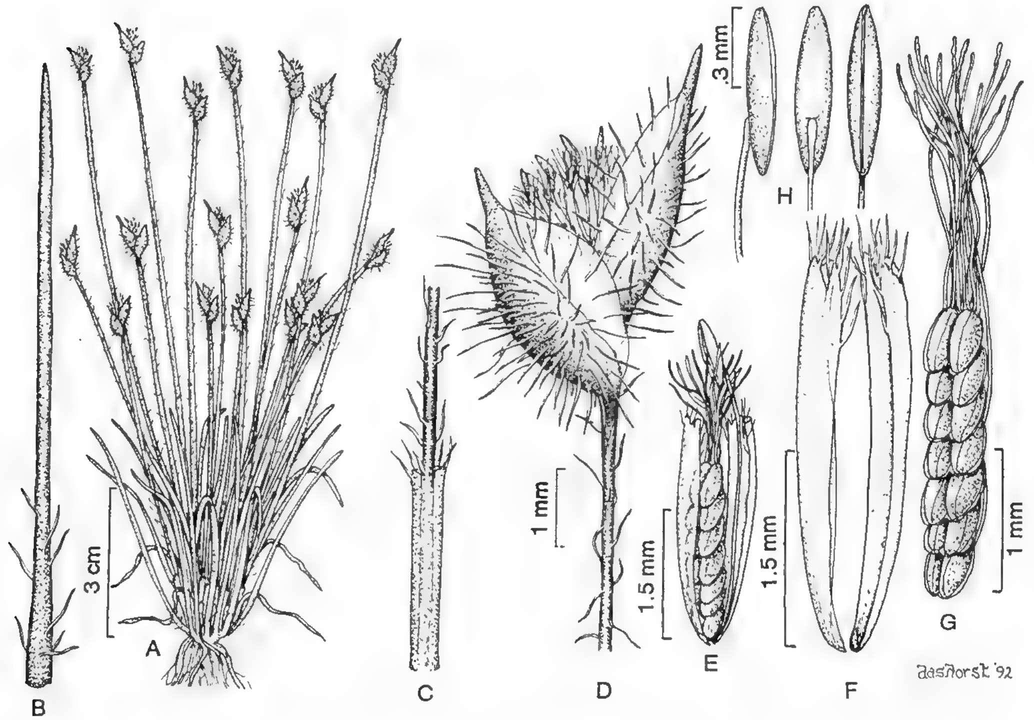


Fig. 10. *Centrolepis exserta.* A, habit; B, leaf; C, base of scape with cataphyll; D, head; E, pseudanthium with secondary bracts; F, secondary bracts; G, gynoecium; H, anther, three views. (Based on *P.K. Latz 2749*: AD).

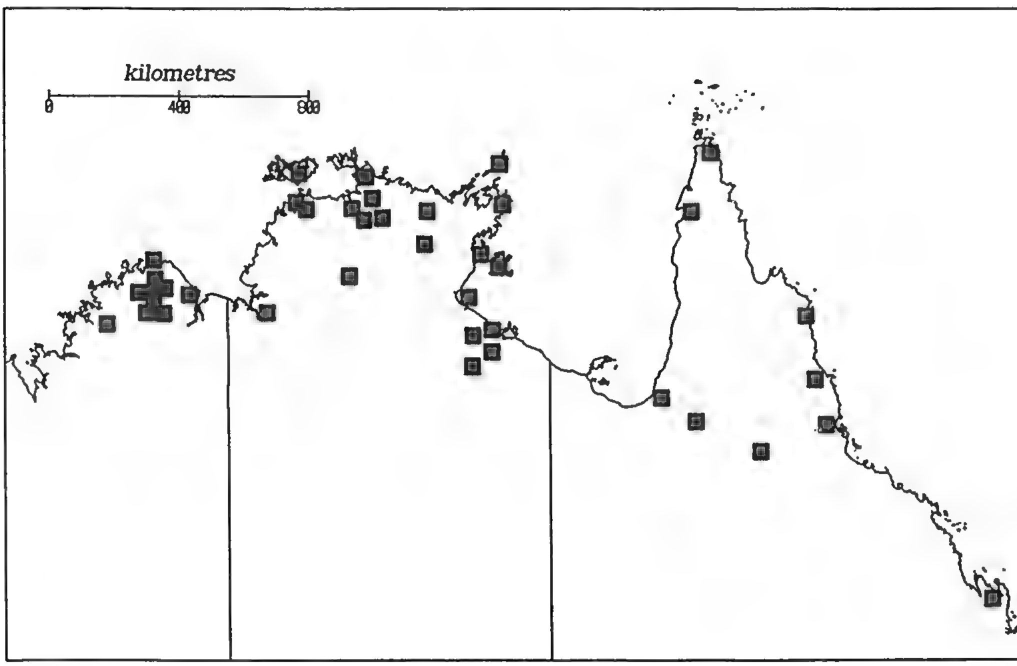
Annual 4-12 cm high, softly herbaceous, forming erect round tufts , often becoming purplish. *Roots* numerous, branched. *Stem* repeatedly branching from the lower axils, forming internodes of negligible length. *Leaves* basal, numerous, regularly radiating in a false spiral phyllotaxy throughout the tuft; sheath 2-6 mm long, membranous with hyaline margins, pilose, passing into a straight, linear-subulate lamina 8-30 mm long, c. 0.4 mm wide, sparsely pilose with patent hairs; apex acute, mucronate. Uppermost leaf reduced to an obtuse, glabrous, hyaline, veinless cataphyll 3-5 mm long. *Scape* terete, filiform, 3-11 cm long, pubescent with fine lax hairs or glabrescent. *Head* terete, narrowly ovoid, c. 2 mm wide. *Primary bracts* separated by an internode 1-3 mm long, rounded on the back, 3-veined, widely gaping at anthesis, similar; sheath narrowly cymbiform, 3-4 mm long, herbaceous, strigose with hairs frequently cystolithic, with broad erose-ciliolate hyaline margins, tapering into a glabrous point 0.5-1.2 mm long. *Secondary bracts* 2 per pseudanthium, hyaline, c. 3 mm long, obtuse, erose-fimbriolate, sometimes with s few hairs near the apex. *Pseudanthia* 10-25, all bisexual. *Stamen* free; filament capillary, 7-15 mm long; anther ellipsoid, 0.8-1.1 mm long. *Gynoecium* of 6-9 carpels; styles c. 2 mm long, pale brown, connate at the base only or free. Stigmatic papillae simple, 0.03 mm long. *Seed* ovoid, c. 0.5 mm long; testa smooth, stramineous. Fig. 10.

Distribution (Map 9)

Western Australia: in the Gardner and Fitzgerald districts of the Kimberley region. *Northern Territory*: widespread from Melville Island to about 16°S. *Queensland*: widespread from Cape York to about 20°S.

Ecology

Annual, growing during the summer wet season. Occurs on margins of streams and wetlands, and moist sites in woodland or grassland, mainly on sandy alluvial soils. *Flowers* in May to August.



Map 9. Distribution of *Centrolepis exserta.*

Notes

Centrolepis exserta is closely related to *C. strigosa*, with which it intergrades at the southern end of its range in Queensland. The two species show homologous variation in overall size, scape length, density of vestiture and degree of anthocyanin pigmentation, but can be reliably separated on the form of the primary bracts and the consequently more open head of *C. exserta.*

The variety *rubra* was described by Bailey as differing only in its smaller size and reddish or purplish colour, and appears to have been based on depauperate material of *C. exserta.*

Selected specimens examined (total 65)

WESTERN AUSTRALIA: Rocky Cove, Van Sittart Bay, 8.viii.1921, *Gardner 1519* (PERTH); 5 km W of Beverley Springs Hstd, 11.viii.1974, *George 12232* (PERTH); Galeola Creek, Drysdale River National Park, 13.viii.1975, *George 13791* (PERTH; CANB); Prince Regent River Reserve, 14.viii.1974, *Kenneally 2002* (PERTH).

NORTHERN TERRITORY: Maria island, 22.vii.1972, *C. Dunlop 3006* (MEL); 17 miles N Wilton River crossing, 15.i.1972, *Latz 2749* (AD; BRI; CANB; NT); Koongara, 8.vi.1978, *Rice 2924* (CANB); South Bay, Bickerton Island, 7.vi.1948, *Specht 492* (AD; BRI; CANB; MEL); Oenpelli, 31.x.1948, *Specht 1311* (BRI).

QUEENSLAND: Lockerbie, Cape York Peninsula, 1.v.1948, *L. Brass 18587* (CANB); army area, Shoalwater Bay, 23.vii.1973, *J. Edwards s.n.* (BRI); track to Pennefeather River, Cape York, 14.vi.1981, *Morton 1253* (MEL); ENE of Weipa Mission, 24.vii.1974, *R. Specht & R. Salt s.n.* (BRI).

10. **Centrolepis banksii** (R. Br.) Roemer & Schultes, Syst. Nat. 1:43 (1817); Kunth, Enum. Pl. 3:490 (1841); Hieron., Abh. Naturf. Ges. Halle 12:213 (1873); F. Muell., Fragm. Phyt. Aust. 8:237 (1874); Benth, Fl. Austral. 7:207 (1878); Bailey, Queensl. Fl. 6:1719 (1902); Ewart & O.Davies, Fl. Northern Terr. 65 (1917).

Devauxia banksii R. Br., Prodr. 253 (1810), basionym; Steudel, Syn. Pl. Glum. 2:267 (1855).

Type: Nova Cambria apud Endeavour River [Qld], 1770, *Banks & Solander* (Lecto. chosen here: BM!; syn.: CANB 67852!).

Devauxia pusilla R. Br., Prodr. 253 (1810); Steudel, Syn. Pl. Glum. 2:267 (1855).

Centrolepis pusilla (R. Br.) Roemer & Schultes, Syst. Nat. 1:44 (1817); Kunth, Enum. Pl. 3:490 (1841); Hieron., Abh. Naturf. Ges. Halle 12:211 (1873); Benth., Fl. Austral. 7:205 (1878); Bailey, Queensl. Fl. 6:1719 (1902).

Type: East coast of New South Wales within the tropic [Qld], 1802, *Brown* sub Bennett No. 5828 bis BM! (Lecto. chosen here as typical of the range of variation, and labelled "Desvauxia pusilla" by Brown. The other Brown collection mounted on the same sheet, from Shoalwater Bay, was not labelled with a name.)

Tufted annual 2.5-12 cm high, softly herbaceous, sometimes becoming purplish after flowering. *Roots* numerous, hardly branched. *Stem* repeatedly branching from lower axils forming internodes of negligible length. *Leaves* basal, numerous, somewhat lax, glabrous, regularly radiating in a false spiral phyllotaxy throughout the tuft; sheath 2-6 mm long, membranous with hyaline margins, passing into a straight linear-subulate lamina 8-45 mm long, c. 1 mm wide, apex acute, emucronate. Uppermost leaf reduced to an obtuse glabrous veinless hyaline cataphyll 3-5 mm long. *Scape* terete, 1.5-11 cm long, glabrous. *Head* terete, ovoid, 2-2.8 mm wide. *Primary bracts* separated by an internode 1-3 mm long, rounded on the back, 3-5-veined, gaping at anthesis; outer bract cymbiform, 3-5 mm long, herbaceous, obtuse or rarely apiculate, with broad hyaline entire to ciliolate margins; inner bract similar, 2.5-4 mm long, always obtuse. *Secondary bracts* 2 per pseudanthium, hyaline, c. 3 mm long, obtuse. *Pseudanthia* 9-25, all bisexual. *Stamen* very shortly adnate to gynoecium; filament capillary, 3-4 mm long; anther ellipsoid, c. 0.6 mm long. *Gynoecium* of 9-20 carpels; styles c. 2 mm long, pale brown, free. Stigmatic papillae simple, 0.03 mm long. *Seed* ovoid, c. 0.5 mm long; testa smooth, stramineous. Fig. 11.

Distribution (Map 10)

Western Australia: scattered in the Gardner and Fitzgerald botanical districts of the eastern Kimberley region. *Northern Territory*: mainly in Arnhem land, but also recorded from the Tanami Desert. *Queensland*: widespread from Cape York to about 18°S.

Also occurring in Vietnam and Hainan (Ding Hou, 1957) and in New Guinea (Royen, 1979).

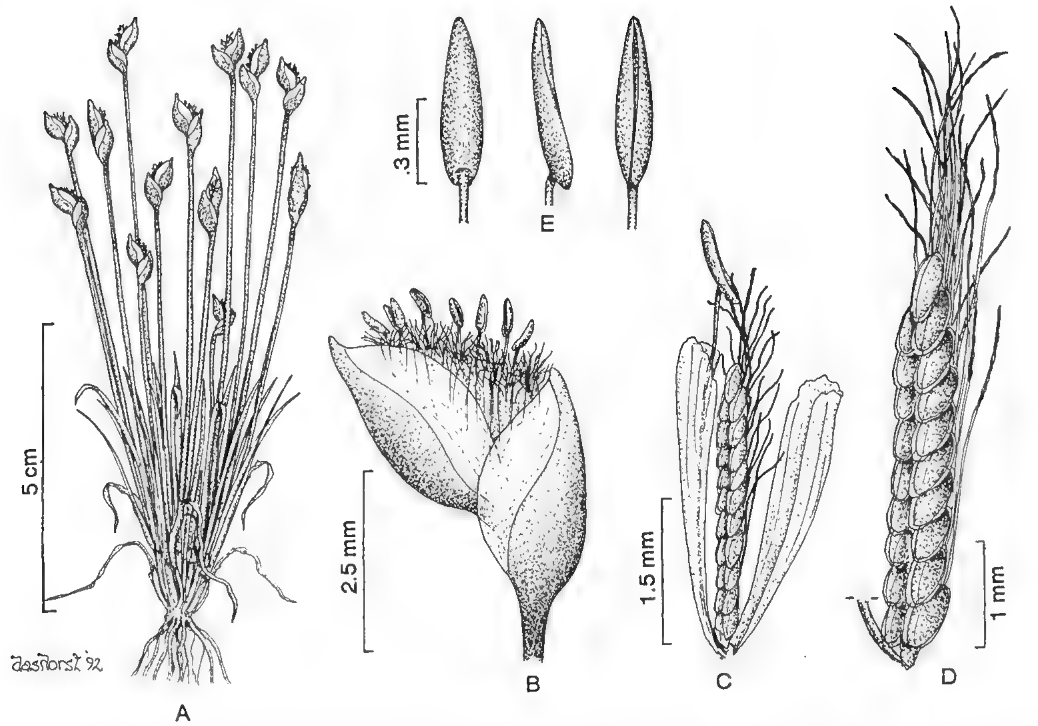


Fig. 11. *Centrolepis banksii.* A, habit; B, head; C, pseudanthium with secondary bracts; D, gynoecium; E, anther, three views. (Based on *D.E. Symon 7687*: AD).

Ecology

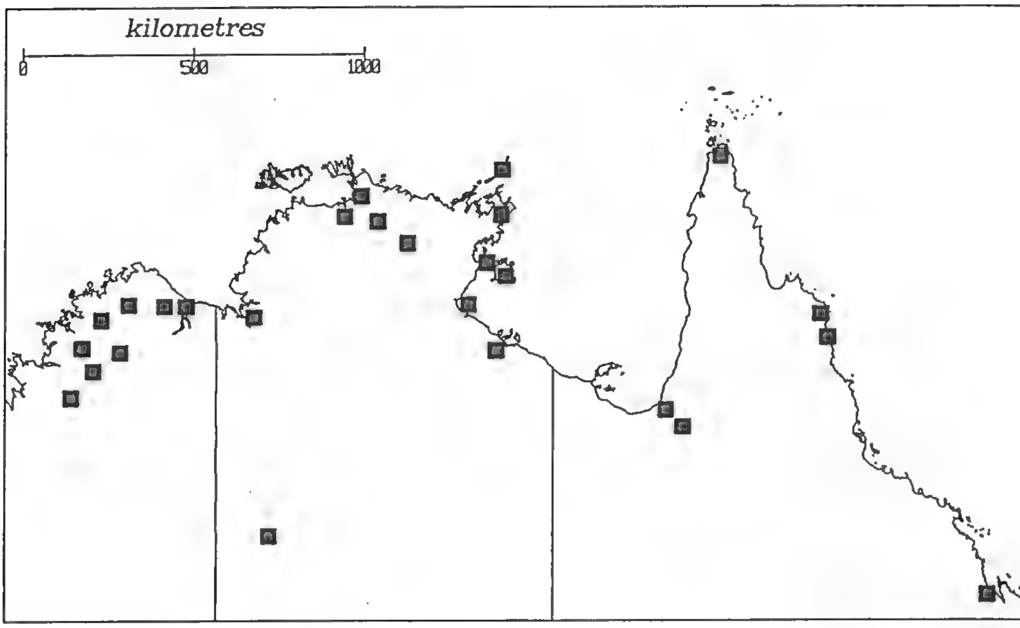
Annual, growing during the summer wet season. *Flowers* mainly May to August. Similar habitat to *C. exserta* and often found with it, but less common.

Notes

Centrolepis banksii appears closely related to *C. strigosa* and also to the Asian species *C. asiatica* Merr. and *C. hainanensis* Merr. & Metcalfe.

Brown's *Devauxia pusilla* was based on depauperate plants with scapes 1.5-3.5 mm long but agreeing with all characters of *C. banksii.* The name *C. pusilla* was misapplied by Specht (1958) to a scapeless annual monocot from *Melaleuca* swamps in Arnhem Land; this plant was later referred to *Trithuria* in the family Hydatellaceae (Cooke, 1981).

An aberrant specimen from a run-on area in the Tanami desert, *Latz 9380*, has a robust condensed habit with relatively numerous pseudanthia. These characters may be adaptations to the extreme environment, but whether they are ecadic or ecotypic in nature is unclear and to base a new taxon on this specimen would be unjustified.



Map 10. Distribution of *Centrolepis banksii.*

Selected specimens examined (total 34)

WESTERN AUSTRALIA: Isdell R. near Grace Knob, v.1905, *Fitzgerald 932* (PERTH); Drysdale River above Mogunda Ck, 6.viii.1975, *George 13471* (PERTH); Orchid Creek below Carson Escarpment, 9.viii.1975, *George 13618* (CANB, PERTH); Nymphaea Creek, Drysdale River National Park, 13.viii.1975, *Kenneally 4280* (PERTH).

NORTHERN TERRITORY: Maria Island, 13.vii.1972, *Dunlop 2813* (CANB); Wessel Islands, 2.x.1972, *Latz 3581* (CANB); 9 km SE of Sangsters Bore, 6.viii.1982, *Latz 9380* (AD); Little Lagoon, Groote Eylandt, 27.v.1948, *Specht 411* (CANB; MEL); Obiri Rock Track, Kakadu, 19.iv.1980, *Telford 7727* (CBG).

QUEENSLAND: 105 km SE Normanton, 17.vii.1974, *Ollerenshaw 1481D* (CBG); 2 km NE Bamaga airstrip, 25.viii.1978, *Paijmans 3009B* (CANB); 27 miles NW Cooktown, 18.vi.1972, *Telford 1398* (BRI; CBG).

11. **Centrolepis pilosa** Hieron., Abh. Naturf. Ges. Halle 12:216 (1873); Benth., Fl. Austral. 7:207 (1878); Diels & Pritzel, Bot. Jahrb. Syst. 35:95 (1904); Blackall & Grieve, West. Aust. Wildfl. 1:60 (1954); Rye in Marchant et al., Fl. Perth Reg. 2:294 (1987).

Type: Western Australia, *J. Drummond 931* (Holo.: B, n.v.; iso.: MEL 57717!, MEL 577261!). The holotype was cited by Hieronymus as located at the Vienna Herbarium (W), but was later removed to Berlin-Dahlem; the sheet is annotated "Hb Hieronymus".

Annual 2.5-9 cm high, softly herbaceous, forming erect tufts, never purplish. *Roots* numerous, branched. *Stem* sparsely branching from the lower axils, forming internodes of negligible length. *Leaves* basal, numerous, very obscurely distichous; sheath 2-3 mm long, membranous with hyaline margins, strigose with multicellular hairs, passing into a linear-subulate arcuate subterete lamina 8-20 mm long, c. 0.3 mm wide, glabrous or with scattered hairs or unicellular papillae; apex obtuse or mucronulate. Uppermost leaf reduced to a veinless obtuse hyaline cataphyll, 2-4 mm long, glabrous or with a few hairs near the apex. *Scape* terete, filiform, 1-8 cm long, glabrous. *Head* ovoid, 2-2.5 mm wide. *Primary bracts* subopposite, similar, rounded on the back, 3-5-veined, gaping at anthesis; sheath broadly

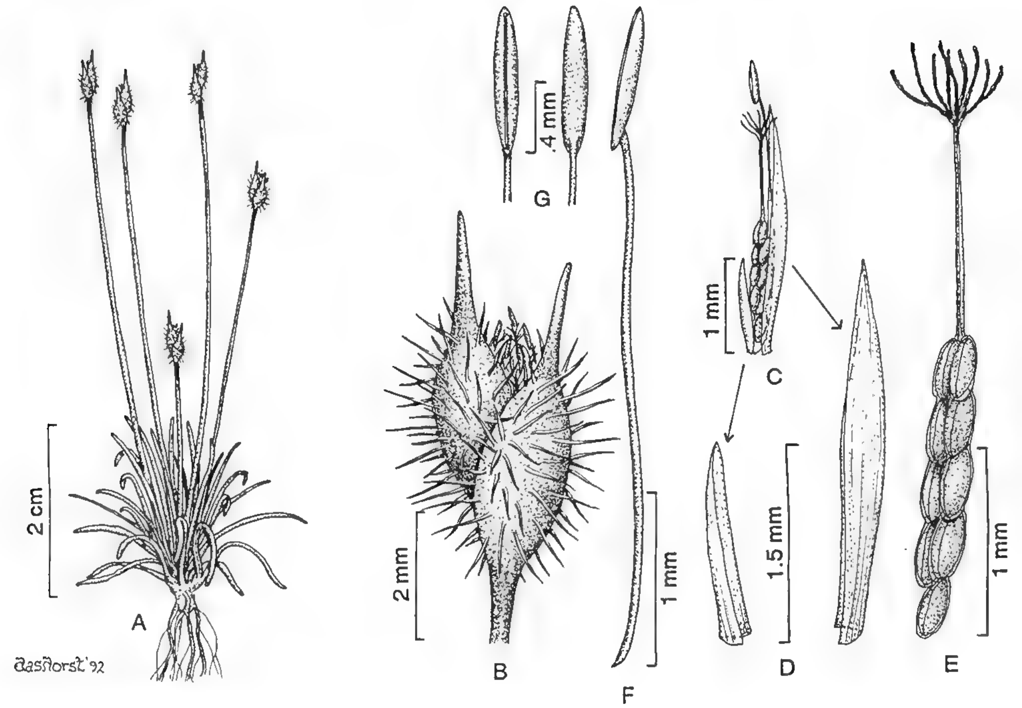


Fig. 12. *Centrolepis pilosa.* A, habit; B, head; C, pseudanthium with secondary bracts; D, secondary bracts; E, stamen (F); F, gynoecium (E); G, anther, two views. (Based on *R.J. Chinnock 4109*: AD)

cymbiform, 2.5-3.5 mm long, herbaceous, densely strigose with narrow, ciliolate to entire hyaline margins, abruptly contracted into an arcuate, terete, leaf-like lamina 2-3 mm long, obtuse, glabrous or minutely papillate. *Secondary bracts* 2 per pseudanthium, c. 2.5 mm long, obtuse, finely erose, hyaline. *Pseudanthia* 8-12, all bisexual. *Stamen* free; filament capillary, c. 3 mm long; anther ellipsoid, 0.8-1 mm long. *Gynoecium* of 5-8 carpels; styles c. 1.5 mm long, connate for about half their length, bright pink; stigmatic papillae branched, 0.04-0.1 mm long. *Seed* ovoid, 0.5 mm long; testa smooth, stramineous. Fig. 12.

Distribution (Map 11)

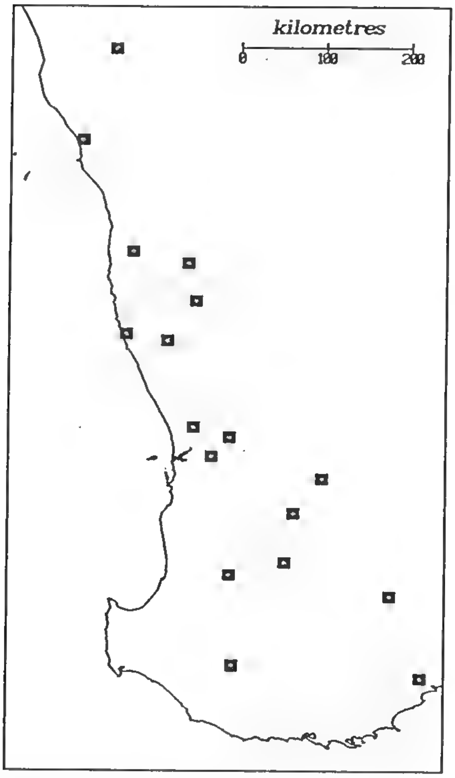
Western Australia: widespread and common in the Avon, Darling and Irwin botanical districts from the Irwin River to Albany, mainly between the 500-1000 mm annual isohyets but with outlying populations to the 350 mm isohyet.

Ecology

Winter annual, on sandy or skeletal soils over granite, limestone and laterite. Often found in lithoseral moss beds but absent from swampy sites. *Flowers* in September to October.

Notes

Close to *C. strigosa*, which replaces it east of Albany; readily recognised by the longer arcuate bract laminae.



Map. 11. Distribution of *Centrolepis pilosa.*

Selected specimens examined (total 17)

WESTERN AUSTRALIA: Dryandra State Forest, 22.xii.1971, *Burbidge 7894A* (CANB); 296 km from Mt Magnet on Geraldton road, 29.x.1963, *Goodall 2150* (PERTH); Darkan townsite, 6.x.1976, *Keighery 877* (PERTH); Mara Bridge, Pallinup River, 6.ix.1974, *Newbey 4243* (PERTH); 8 km E Dandaragan West, 2.x.1972, *Paust 1136* (PERTH); Manjimup, 28.ix.1948, *Royce 2720* (PERTH); Tutanning Reserve, 18.ix.1962, *Royce 7546* (PERTH); Watheroo National Park, 4.x.1971, *Royce 9541* (PERTH); 13 miles W of Coorow, 30.ix.1966, *Scrymgeour 1388* (PERTH); Helena Valley, 26.ix.1977, *Seabrook 304* (PERTH); Nambung National Park, 12.x.1978, *Spencer 13* (MEL); 5 km S of Eneabba, 11.x.1978, *Spencer 14* (MEL).

12. **Centrolepis fascicularis** Labill., Nov. Holl. Pl. 1:7-8, t.1 (1804); Roemer & Schultes, Syst. Nat. 1:43 (1817); Desv., Ann. Sci. Nat. (Paris) 13:42 (1828); Kunth, Enum. Pl. 3:489 (1841); J.D. Hook., Fl. Tasman. 2:77 (1858); Hieron., Abh. Naturf. Ges. Halle. 12:216 (1873); Benth., Fl. Austral. 7:207 (1878); Tate, Handb. Fl. Extratrop. S. Aust. 177 (1890); Bailey, Queensl. Fl. 6:1719 (1902); Rodway, Tasm. Fl. 232 (1903); Bailey, Weeds Susp. Poison Pl. Queensl. 209 (1906); J. Black, Fl. S. Aust. 1:102 (1922); Ewart, Fl. Vict. 261 (1931); Ding Hou, Fl. Males. 5:424 (1957); J.H. Willis, Handb. Pl. Vict. 1:279 (1962); N. Beadle et al., Fl. Sydney Reg. 591 (1972); Cooke in Jessop & Toelken, Fl. S. Aust. 4:1826 (1986).

Type: in capite Van Diemen [Tas.], 1792, *Labillardière* (Holo.: FI, n.v.; iso.: B, microfiche, BM, n.v.).

Devauxia billardieri R. Br., Prodr. 252 (1810); Steudel, Syn. Pl. Glum. 2:267 (1855).

Type: in paludosis prope Sydney [N.S.W.], *Brown* (Lecto. chosen here: BM!; syn.: MEL 535282!; MEL 536057!).

Centrolepis cuspidigera Rudge, Trans. Linn. Soc. London 10:283 (1811).

Type: fig. 1, t.12 loc. cit.

Devauxia longifolia Gaudich., Voy. Uranie 419 (1829), ut "Desvauxia".

Centrolepis longifolia (Gaudich.) Kunth, Enum. Pl. 3:489 (1841).

Type: in Novae Hollandiae ora orientali (Port Jackson) [N.S.W.], *Gaudichaud* (Holo.: P, photo!).

Perennial, softly herbaceous, never becoming purplish, forming dense cushions 3-20 cm diam. *Stems* numerous, branching, with numerous adventitious roots. *Leaves* numerous, very obscurely distichous; sheath 2-6 mm long, membranous with hyaline margins, pilose with multicellular hairs, passing into a linear-subulate subterete lamina 8-45 mm long, c. 0.8 mm wide, glabrous or pilose with scattered hairs; apex acute, mucronulate. Uppermost leaf reduced to a veinless subacute hyaline cataphyll, 3-5 mm long, glabrous. *Scape* terete,

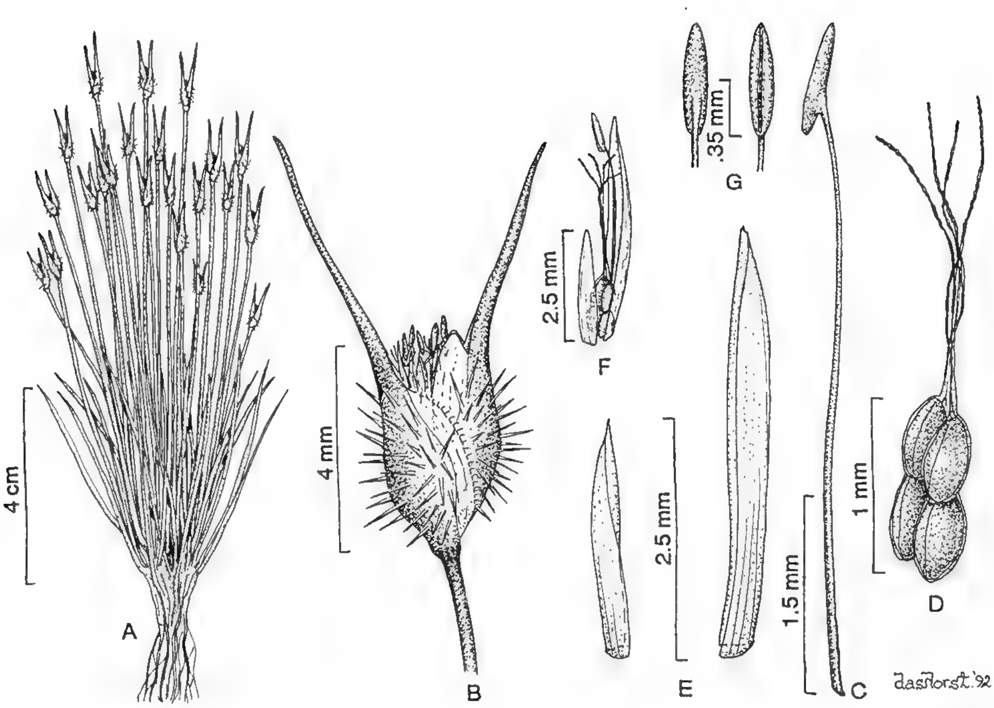


Fig. 13. *Centrolepis fascicularis.* A, habit; B, head; C, pseudanthium with secondary bracts; D, gynoecium; E, secondary bracts; F, stamen; G, anthers, two views. (Based on *J.B. Cleland AD 97226057*).

filiform, 2-6 cm long, glabrous. *Head* ovoid, 2-3.5 mm wide. *Primary bracts* subopposite, similar, rounded on the back, 3-veined, gaping at anthesis; sheath broadly cymbiform, 2.5-3.5 mm long, herbaceous, usually densely strigose with narrow hyaline margins, tapering into a subulate leaf-like lamina 1-3 mm long, acute, glabrous or minutely papillate. *Secondary bracts* 2 per pseudanthium, 2.5-3.5 mm long, obtuse or truncate, hyaline. *Pseudanthia* 7-14, all bisexual. *Stamen* free; filament capillary, 2.5-4 mm long; anther ellipsoid, 0.6-0.8 mm long. *Gynoecium* of 2-4 carpels; styles c. 2 mm long, connate at the base only, pale brown; stigmatic papillae simple, c. 0.04 mm long. *Seed* ovoid, c. 0.5 mm long; testa smooth, stramineous. Fig. 13.

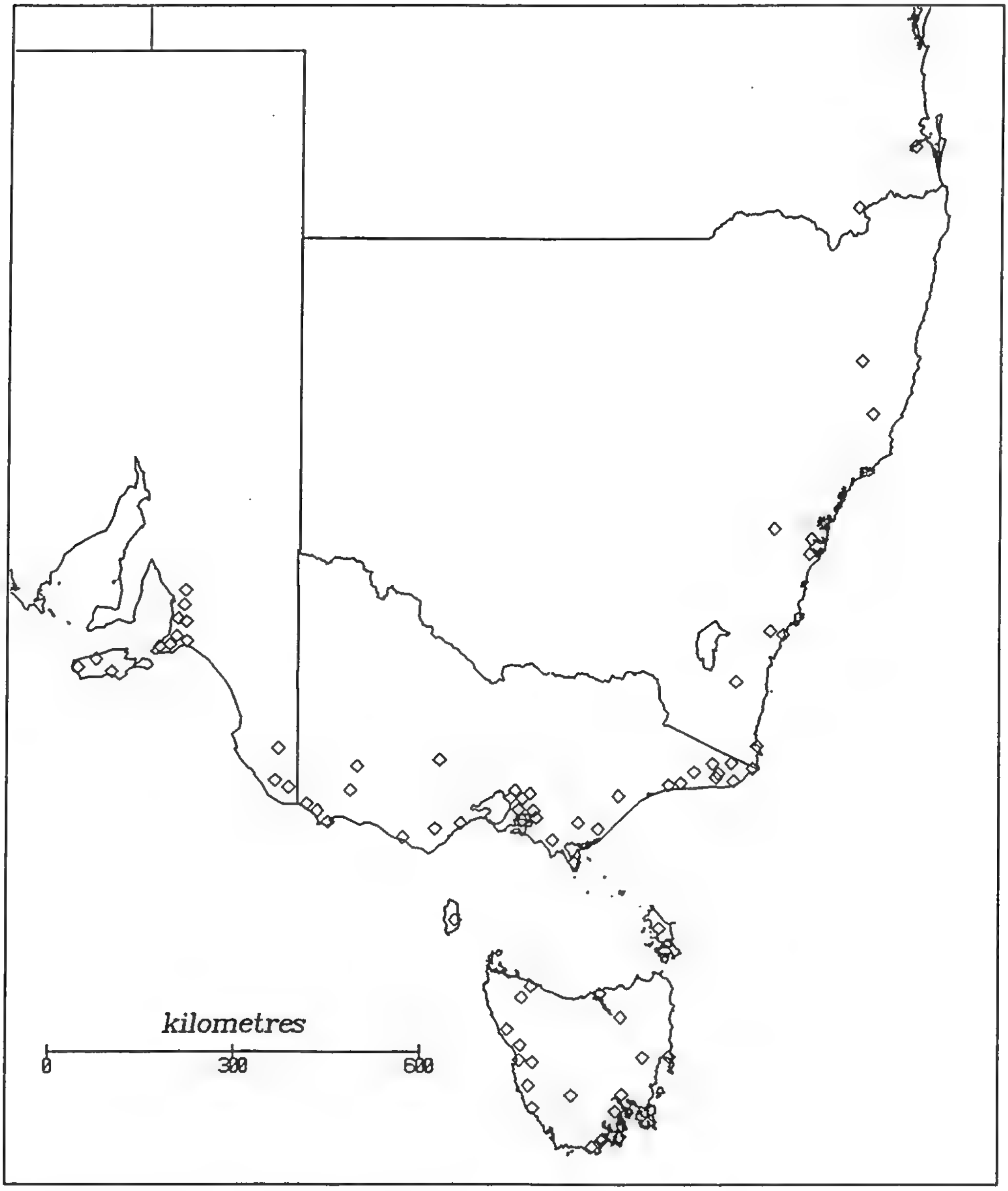
Distribution (Map 12)

Western Australia: possibly introduced at Bramley in the far south-west. *South Australia*: Kangaroo Island, Southern Lofty and lower South-east. *Queensland*: Along the Great Dividing Range in the south-east. *New South Wales*: widespread along the Coast and Tablelands of the Dividing Range. *Victoria*: along the coast and southern side of Dividing Range. *Tasmania*: widespread at low altitudes.

Also native to the highlands of New Guinea and Borneo (Ding Hou, 1957; Royen, 1979).

Ecology

Winter-growing evergreen perennial of habitats with the water table close to the surface



Map 12. Distribution of *Centrolepis fascicularis.*

throughout the year, from coastal swamps to alpine peat bogs. *Flowers* in November to February.

Notes

Resembles the annual species *C. pilosa* and *C. strigosa*; however, the lower seed production, with about three carpels per pseudanthium but often only one producing a seed, implies a *K*-strategy associated with the perennial habit.

Selected specimens examined (total 157)

WESTERN AUSTRALIA: Bramley, Margaret River district, 20.x.1951, *Royce 3821* (PERTH).

SOUTH AUSTRALIA: Boyles Swamp, Mylor, 19.i.1977, *Bates 2072* (AD); 4 km NE of Yundi, 20.xi.1976, *Bell 35* (AD); near Rocky River, Flinders Chase, 6.i.1966, *Eichler 18601* (AD); Mt Gambier Forest, 21.ii.1985, *Greenham 431* (AD).

QUEENSLAND: Stanthorpe, xii.1883, *Scortechini s.n.* (MEL).

NEW SOUTH WALES: Ulladulla, 1883, *Bauerlen s.n.* (MEL); Govetts Leap, Blackheath, 10.xii.1964, *Constable 5583* (NSW; MEL); South Coast, 36°06'S 149°32'E, 29.iii.1974, *Craven 2562* (CANB); Jennings - Boonoo Boonoo track, i.1956, *Gray s.n.* (CANB); South Coogee, 26.ix.1964, *Mair s.n.* (NSW).

VICTORIA: Portland Sanctuary Swamp, 11.ii.1950, *Beauglehole 39703* (MEL); St. Georges Plain, 37°38'S 149°03'E, 27.v.1980, *Cooke 285* (MEL); 10 miles NE of carlisle, Otway Ranges, 15.x.1960, *Muir 1800* (MEL); Grampians near Halls Gap, n.d., *Sharrad 506* (AD); Tidal River, Wilsons Promontory, 2.i.1965, *Specht 2908* (MELU); Belgrave, i.1933, *Willis s.n.* (MEL).

TASMANIA: Strahan, 22.i.1949, *Blake 18397* (HO); Birches Inlet Hut, 15.xi.1983, *Buchanan 1360* (AD, HO); King Island., 9.iv.1966, *Cameron s.n.* (HO); road to Hansons Mill, Snug Plains, 28.i.1960, *Jackson s.n.* (HO); Condominium Ck, Scotts Peak road, 4.1.1977, *Mason 13186* (HO); Killiecrankie bay, Flinders Island, 20.xi.1966, *Whinray 7* (HO).

13. **Centrolepis curta** D.A. Cooke, sp. nov.

Herba annua nana caespes rotundatos 2-4 cm diametro formans. *Radices* numerosi parce ramificantes. *Caulis* brevissimus ex axillis foliarum inferiorum ramificans. *Folia* tot basalia pseudospiraliter radiata vaginis membranaceis 1.5-3 mm longis c. 0.6 mm latis in laminis linearibus subapplanatis laxis 6-24 mm longis c. 0.3 mm latis transientibus, in vaginis et partibus proximalibus laminarum sparsim pilosa; apices foliorum acuti mucronulati. Folium summum ad cataphyllum subacutum hyalinum glabrum enervatum 2-2.5 mm longum reductum. *Scapus* absens. *Capitulum* sessilia vel subsessilia, conferta, cylindrica, c. 2 mm diametro, foliis persuperata. *Bracteae* primariae oppositae, ecarinatae, uninervatae, capitulum includentes; exteriora vagina membranacea 1.7-2.5 mm longa, sparsim pilosa, ciliolata, in lamina 0.8-3.2 mm longa transiente; interiora similis lamina 0.5-2 mm longa. *Pseudanthia* 4-6 bisexualia, unumquidque bracteis secundariis 2 anguste oblongis 1.7-2.2 mm longis truncatis eroso-fimbriatis hyalinis. *Stamen* unicum, gynophoro discretum, filamento 3-4 mm longo, anthera c. 1 mm longa ellipsoidea exserta. *Gynoecium* 4-10 carpidio in stylis c. 2 mm longis fere discretis papillis stigmatum simplicibus. *Semen* ovoideum, c. 0.4 mm longum; testa laeve, straminea.

Type: Blyxa Creek, Prince Regent River Reserve, 15°48'S 125°20'E, 19.viii.1974, *A.S. George 12423* (Holo: PERTH!).

Annual dwarf herb forming rounded tufts 2-4 cm diam. *Roots* numerous, sparsely branched. *Stem* branching from the lower axils to form internodes of negligible length. *Leaves* all basal, regularly radiating in a false spiral phyllotaxy throughout the tuft; sheath 1.5-3 mm long, c. 0.6 mm wide, membranous with hyaline margins, sparsely pilose, passing into a straight linear lamina 6-24 mm long, c. 0.3 mm wide, ± flattened, sparsely pilose near the base with hairs decreasing in length distally; apex acute, mucronulate. Uppermost leaf reduced to a subacute veinless glabrous hyaline cataphyll 2-2.5 mm long. *Scape* absent. *Head* sessile or terminal on internodes to 1 mm long, cylindric, c. 2 mm diam., crowded in the centre of the tuft and far exceeded by the leaves. *Primary bracts* opposite, rounded on the back, 1-veined, loosely enclosing the head; outer bract with a membranous sheath 1.7-2.5 mm long, sparsely pilose with ciliate margins, passing into a leaf-like lamina 0.8-3.2 mm long; inner bract similar but with a lamina 0.5-2 mm long. *Pseudanthia* 4-6, all bisexual. *Secondary bracts* 2 per pseudanthium, narrow-oblong, 1.7-2.2 mm long, truncate with erose-fimbriate apices, hyaline. *Stamen* free from gynophore; filament capillary, 3-4 mm long; anther ellipsoid, c. 1 mm long, exserted. *Gynoecium* of 4-10 carpels; styles free, c. 2 mm long, pale brown; stigmatic papillae simple, c. 0.03 mm. *Seed* ovoid, c. 0.4 mm long; testa smooth, stramineous. Fig. 14.

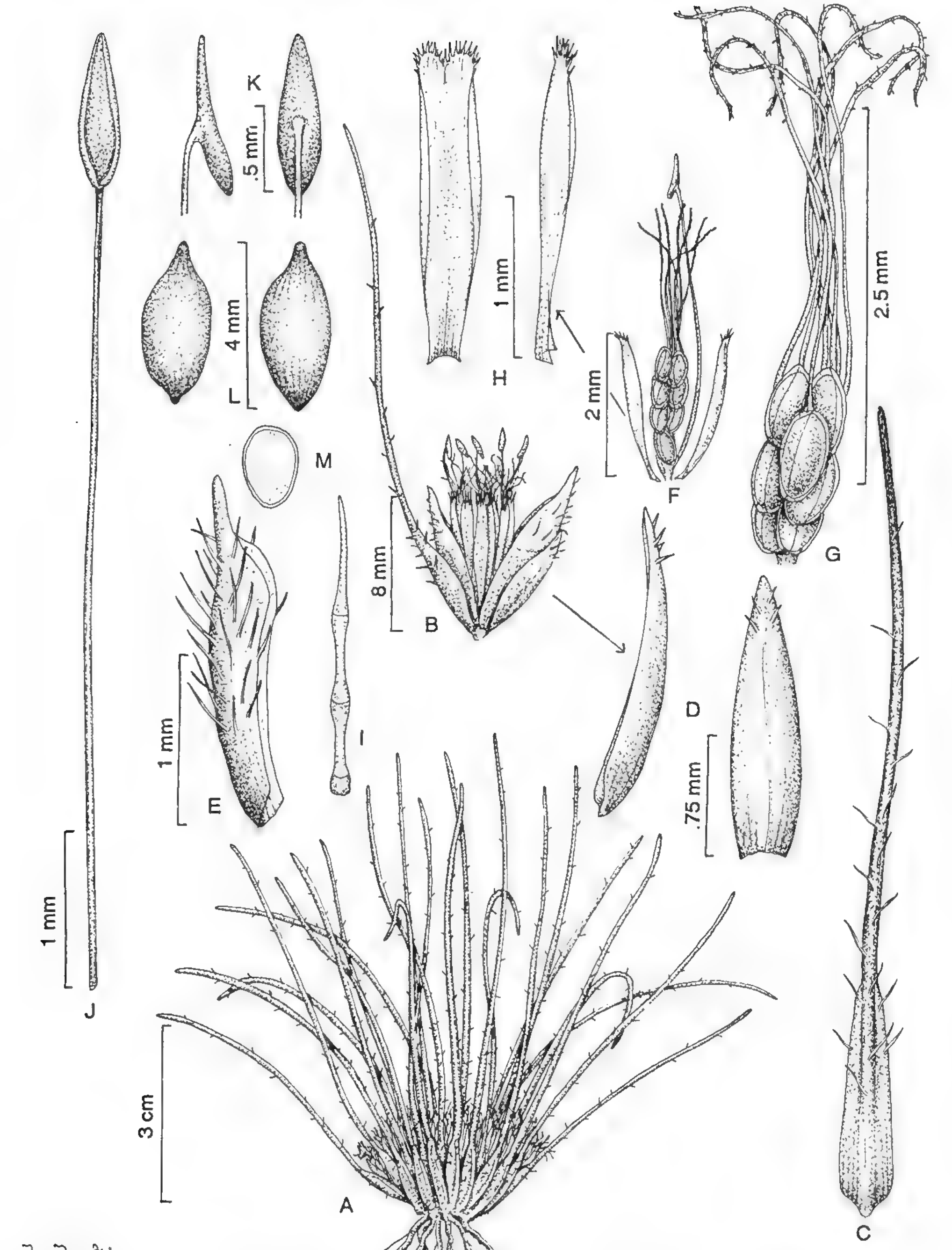
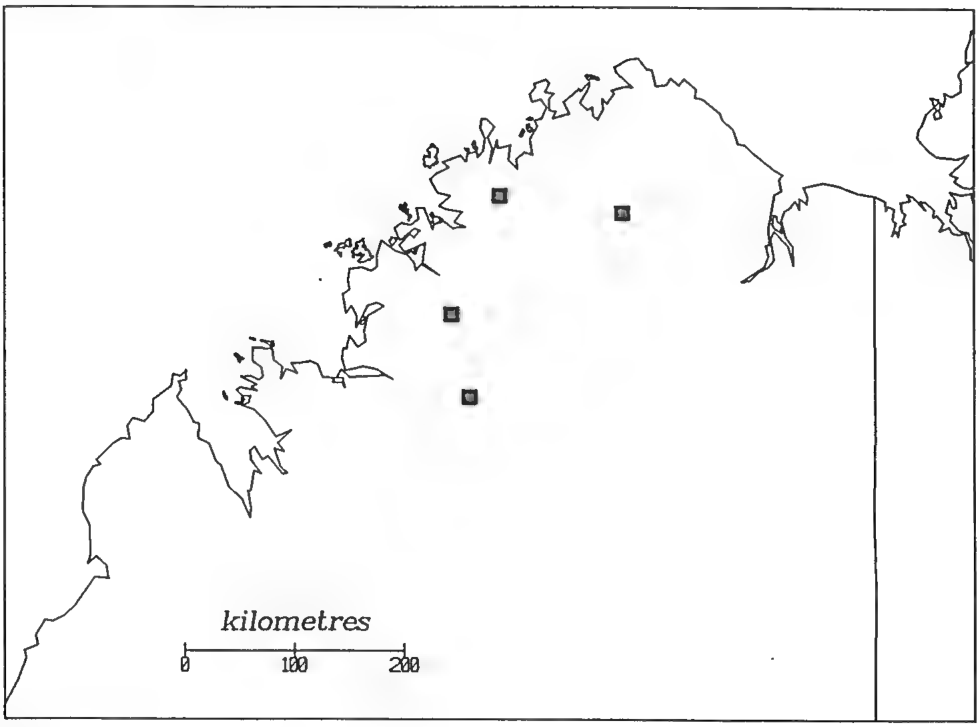


Fig. 14. *Centrolepis curta.* A, habit; B, head, leaf and cataphyll; C, leaf; D, cataphyll, two views; E, outer primary bract; F, pseudanthium with secondary bract; G, gynoecium; H, secondary bract, two views; I, hair off outer primary bract; J, stamen; K, anther, two laterial views; L, seed, two lateral views; M, seed, cross section view. (Based on *A.S. George 12423*: PERTH).

Distribution (Map 13)

Western Australia: endemic to the Kimberley District north of 17°S latitude, within the Gardner botanical district of Beard (1980).



Map 13. Distribution of *Centrolepis curta.*

Ecology

Occurs in open woodland and low grassland, in moist microhabitats such as seepage areas and alluvial flats. *Flowering* is recorded in May to August.

Notes

This species is placed with the *C. strigosa* group on the evidence of its multicellular hairs, radially arranged leaves, free styles and large secondary bracts but differs from them in its scapeless habit. It is readily distinguished from all other scapeless species by the presence of hairs on the leaves and primary bracts.

Etymology

Latin *curtus*, short; referring to the low stature of the plant due to its scapeless habit.

Specimens examined

WESTERN AUSTRALIA: ± 5 km W of Beverley Springs homestead, 11.viii.1974, *George 12233* (PERTH); above Carson Escarpment S of Coucal Gorge, Drysdale River National Park, ± 15°02'S 126°49'E, 16.viii.1975, *George 13911* (PERTH); Gauging station, Camp Creek c. 12 km SW of mining camp, Mitchell Plateau, 14°53'10"S 125°45'05"E, 3.v.1982, *Kenneally 8227* (PERTH).

14. **Centrolepis drummondiana** (Nees) Walp., Ann. Bot. Syst. 1:896 (1849) ut *C. drummondii*; F. Muell., Fragm. Phyt. Aust. 8:237 (1874); Benth., Fl. Austral. 7:206 (1878); J. Black, Fl. S. Aust. 1:102 (1922); Blackall & Grieve, West. Aust. Wildfl. 1:59 (1954); Cooke in Jessop & Toelken, Fl. S. Aust. 4:1826 (1986); Rye in Marchant et al., Fl. Perth Reg. 2:926 (1987).

Devauxia drummondiana Nees, Ann. Mag. Nat. Hist. ser. 1, 6:51 (1841), basionym.

Type: ad flumen cygnorum [W.A.], *Drummond s.n.* (Holo.: B n.v.; iso.: MEL 559507!, MEL 559508!). The holotype bears the annotations "Hb Lindley" and "Hb Nees".

Devauxia drummondii Nees in Lehm., Pl. Preiss. 2:70 (1846), sphalm. orthog., ut '*Desvauxia drummondii*'; Steudel, Syn. Pl. Glum. 2:267 (1855).

Devauxia brevifolia Nees in Lehm., Pl. Preiss. 2:70 (1846) ut '*Desvauxia*'; Steudel, Syn. Pl. Glum. 2:267 (1855).

Centrolepis brevifolia (Nees) Walp., Ann. Bot. 1:896 (1849); Hieron., Abh. Naturf. Ges. Halle 12:212 (1873).

Type: summi montis Clarence, Plantagenet [W.A.], Sept. 1840, *Preiss 1749*. (Holo.: B n.v.; iso.: MEL 536055!). The holotype bears the annotation "Hb Nees".

Devauxia urvillei Steudel, Syn. Pl. Glum. 2:267 (1855); *Centrolepis urvillei* (Steudel)Hieron., Abh. Naturf. Ges. Halle 12:214 (1873).

Type: Portum Georgii, N. Holl.[W.A.], *Urville* (Holo.: P photo.!).

Centrolepis pulchra Hieron., Abh. Naturf. Ges. Halle 12:213 (1873).

Type: Western Australia, *Drummond 930* (Holo.: B n.v.; iso.: MEL 1513045!). Hieronymus cited the holotype from the Vienna Herbarium (W), but it was later removed to Berlin-Dahlem; the sheet is annotated "Hb Hieronymus".

Tufted annual 2-11 cm high, softly herbaceous. *Roots* numerous, hardly branched. *Stem* very short, repeatedly branching from the lower leaf axils to form internodes of negligible length. *Leaves* numerous, basal, very obscurely distichous, lax; sheath 2-5 mm long, membranous with hyaline margins sometimes bearing scattered crisped hairs, passing into a straight linear lamina 4-30 mm long, c. 0.4 mm wide, glabrous or microscopically papillate; apex acute, mucronate. Uppermost leaf reduced to an obtuse veinless hyaline cataphyll 3-7 mm long, sometimes with a few hairs at apex. *Scape* terete, filiform, 1.5-10 mm long, glabrous. *Head* terete, narrowly ovoid to pyriform, 1.6-2.5 mm wide. *Primary bracts* subopposite, separated by an internode to 2 mm, rounded on the back, 3-5-veined, glabrous or sparsely papillate, tightly sheathing; outer bract with a sheath 2.5-6 mm long, herbaceous with entire scarious margins, passing abruptly into a filiform lamina 0.5-3.5 mm long; inner bract, slightly smaller. *Secondary bracts* 2 per pseudanthium, 2-4 mm long, acute, erose, hyaline. *Pseudanthia* 4-12, bisexual, 4-6 in each bract or all in the inner bract. *Stamen* free or very shortly adnate to gynophore; filament capillary, 3-4 mm long; anther ovoid-ellipsoid, 1-1.8 mm long. *Gynoecium* of 4-7 carpels; styles 2-3 mm long, connate for half their length, pale brown; papillae simple, c. 0.03 mm. *Seed* ovoid, c. 0.5 mm long; testa smooth, stramineous. Fig. 15.

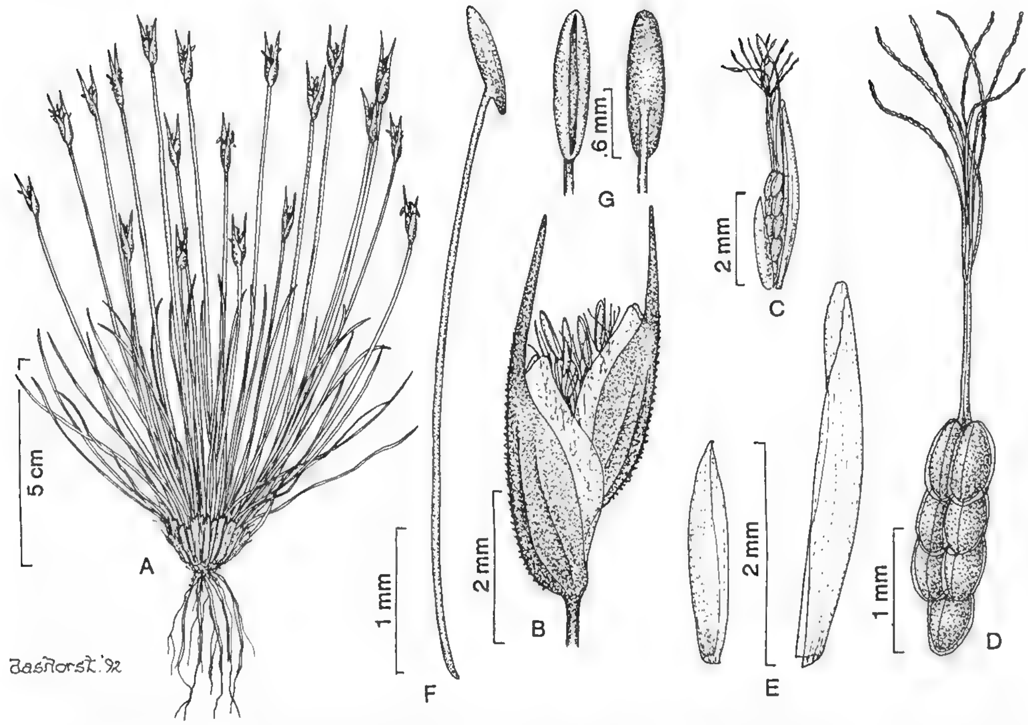


Fig. 15. *Centrolepis drummondiana.* A, habit; B, head; C, pseudanthium with secondary bracts; D, gynoecium; E, secondary bracts; F, stamen; G, anthers, two views. (Based on *J.B. Cleland* AD 97226057).

Distribution (Map 14)

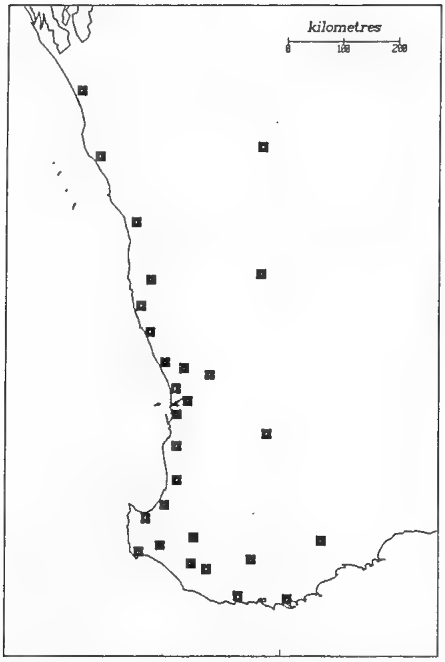
Western Australia: widespread and common from Shark Bay south and east to the Porongorups, in the Irwin, Darling and Avon botanical districts. *South Australia*: recorded by one collection from Wooltana Station in the Flinders Ranges, where it is possibly a casual introduction.

Ecology

Winter annual, *flowering* in September to November. Grows in a wide variety of habitats including sand heath, lithoseral moss beds and swampy sites on clay soils.

Notes

Nees (1847) published the name *Devauxia drummondii* (genitive of the surname 'Drummond'), repeating verbatim his 1841 description of *D. drummondiana* (adjective formed from the same surname) and citing both the type of that name and another specimen, *Preiss 1809*. The spelling *drummondii* has been taken up by subsequent authors including Walpers (1849), who transferred this species to *Centrolepis* but cited Nees (1841) as the source of the epithet. According to the Code, the incorrect use of such terminations as -ii and -ianus is treated as an orthographic error; therefore, the original spelling of *drummondiana* is here upheld.



Map. 14. Distribution of *Centrolepis drummondiana.*

Selected specimens examined (total 50)

WESTERN AUSTRALIA: Augusta, 27.x.1983, *Corrick 8950* (AD; MEL); 29 miles [47 km] W of Mt Magnet, 11.ix.1966, *George 7980* (PERTH); summit of Mt Hassell, Stirling Range, 18.x.1977, *Keighery 1220* (PERTH); Bayswater, 29.xi.1906, *Morrison s.n.* (PERTH); Cowallelup Reserve, 23.ix.1978, *Newbey 5128* (PERTH); Wongan Hills, 13.ix.1947, *Royce 2180* (PERTH); Daradup, 22.x.1948, *Royce 2921* (PERTH); Nancys Peak, Porongorup Range, 29.x.1959, *Royce 6125* (PERTH); Brand Hwy 30 km S of Eneabba, 12.x.1978, *Spencer 5* (MEL); Nambung National Park, 12.x.1978, *Spencer 12* (MEL); Peak Charles - Lake King road, 28.xi.1973, *Weston 9023* (PERTH).

SOUTH AUSTRALIA: Wooltana Station, xii.1920, *White s.n.* (AD 97516023).

15. **Centrolepis mutica** (R. Br.)Hieron., Abh. Naturf. Ges. Halle 12:211 (1873); Benth., Fl. Austral. 7:204 (1878).

Alepyrum muticum R. Br., Prodr. 253 (1810), basionym; Roemer & Schultes, Syst. Nat. 1:44 (1817); Kunth, Enum. Pl. 3:488 (1841); Steudel, Syn. Pl. Glum. 2:266 (1855).

Type: banks of Oyster Harbour, King Georges Sound [W.A.], Dec.1801, *Brown* sub Bennett No. 5836 (Holo.: BM!).

Slender erect annual 3-7 cm high, rigidly herbaceous, becoming purplish after flowering. *Roots* numerous, hardly branched. *Stem* densely branching, forming internodes of negligible length. *Leaves* few, basal, obscurely distichous, lax, glabrous; sheath hyaline-scarious, 2-4 mm long, passing into a linear subterete lamina 4-11 mm long, c. 0.3 mm wide; apex obtuse, emucronate. Uppermost 1 or 2 leaves reduced to obtuse veinless hyaline-scarious cataphylls 2-4 mm long. *Scape* capillary, 1-6 cm long, terete, glabrous. *Head* terete, ovoid-conic, 1-2 mm wide. *Primary bracts* subopposite, rounded on the back, 3-veined, glabrous, tightly enclosing the head; outer bract with a sheath c. 3 mm long, herbaceous with regularly ciliolate narrow hyaline margins, acuminate or produced into a straight foliar point to 1 mm long; inner bract similar but with entire margins, the acute apex never produced into a foliar point. *Secondary bracts* absent. *Pseudanthia* 3-6, bisexual. *Stamen* shortly adnate to the gynophore; filament capillary, 2.5-3.5 mm long; anther ellipsoid, c. 0.5 mm long. *Gynoecium* of 5-8 carpels; styles c. 2 mm long, connate at the base, brown; stigmatic papillae simple, c. 0.02 mm long. Seed ovoid, c. 0.5 mm long; testa smooth, stramineous. Fig. 16.

Distribution (Map 15)

Western Australia: scattered in the Darling botanical district of the south-west from Perth to Albany between the 700 and 1100 mm annual isohyets.

Ecology

Winter annual of sand heath and woodland on low-nutrient soils, *flowering* in November.

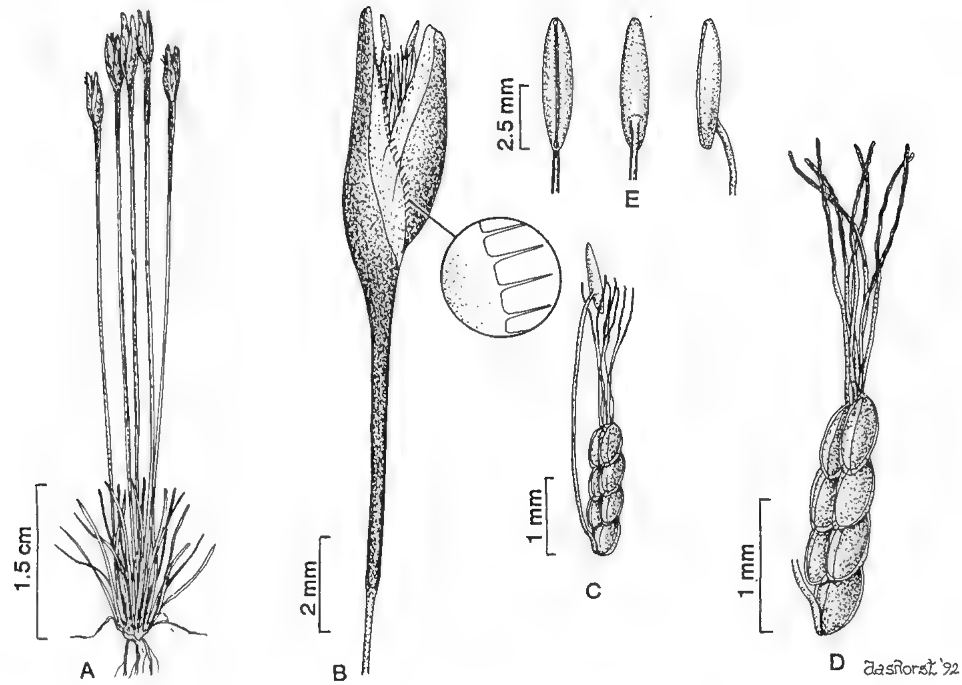


Fig. 16. *Centrolepis mutica.* A, habit; B, head; C, pseudanthium; D, gynoecium; E, anther, 3 views. (Based on *A. Morrison* PERTH 02039222).

Notes

C. mutica closely resembles *C. drummondiana*, but with a more gracile habit and fewer pseudanthia associated with a niche further from the ruderal strategy. In this it parallels the relationship between *C. alepyroides* and *C. aristata* in the same region, and also shows convergence with *C. polygyna* in its habit and loss of secondary bracts.

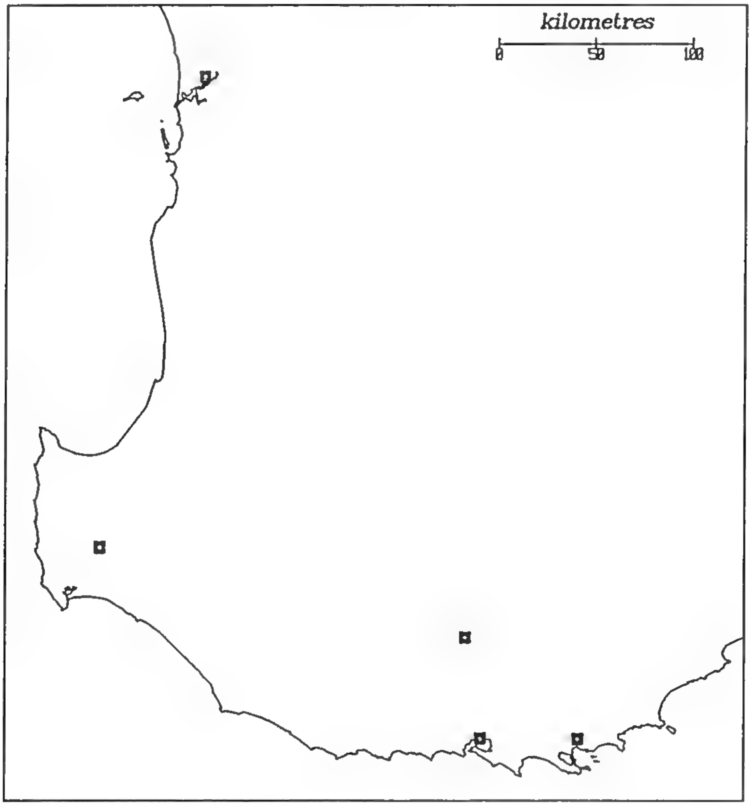
This name has been widely misapplied, all material of *C. mutica* in Australian herbaria having previously been referred to the commoner *C. drummondiana*. Mentions of *C. mutica* in local literature (eg. Blackall & Grieve, 1954) cannot be referred to any species with certainty.

Specimens examined

WESTERN AUSTRALIA: Bayswater, 14.xii.1904, *Morrison s.n.* (PERTH); Bayswater, 29.xi.1906, *Morrison s.n.* (PERTH); Blackwood River, xi.1877, *Mueller s.n.* (MEL); between Frankland and Mt Barker, 12.xii.1974, *Pullen 9998B* (CANB); n. loc., 1944, *Royce s.n.* (PERTH); c. 1 mile E of Denmark/Albany junction, 21.xi.1980, *Webster 643* (PERTH).

16. **Centrolepis eremica** D.A. Cooke in Jessop & Toelken, Fl. S. Aust. 4:1826 (1986).

Type: Everard Range, S. Aust., ix.1968, *A.G. Spooner 73* (Holo.: AD 96845116!).



Map 15. Distribution of *Centrolepis mutica*.

Annual 2-4 cm high forming dense hemispherical tufts to 6 cm diam., rigidly herbaceous, never purplish. *Roots* numerous, hardly branched. *Stem* very short, repeatedly branching from the lower axils, forming internodes of negligible length. *Leaves* few to many, not distichous, glabrous; sheath 1-5 mm long, scarious, passing into a recurved terete linear lamina 5-12 mm long, 0.5-0.8 mm wide; apex obtuse, emucronate. Uppermost leaf reduced to an obtuse veinless glabrous scarious cataphyll c. 2 mm long. Scape terete, 1-3 cm long, glabrous. Head ovoid-conic, 1-2 mm wide. Primary bracts opposite, rounded on the back, glabrous, closely sheathing; outer bract with a brown cartilaginous 1-veined sheath 2-3.5 mm long passing abruptly into a lamina 2-8 mm long; inner bract 1.8-3 mm long, acute, brown cartilaginous, lacking a lamina. *Secondary bracts* absent. *Pseudanthia* 4-10, bisexual or a minority lacking the stamen. *Stamen* free; filament capillary, 2-3 mm long; anther ovoid, 1-1.2 mm long. *Gynoecium* of 6-20 carpels; styles c. 2 mm long, connate at the base, pale brown; stigmatic papillae simple, c. 0.03 mm long. *Seed* ovoid, c. 0.5 mm long; testa smooth, stramineous. Fig. 17.

Distribution (Map 16)

Western Australia: Austin, Helms and Giles botanical districts of the Eremaean province. *Northern Territory*: widespread south of 20°S. *South Australia*: extending south to northern Eyre Peninsula and the plains around Lake Torrens but absent from the Flinders Ranges. *New South Wales*: localised in the north far western plains region.

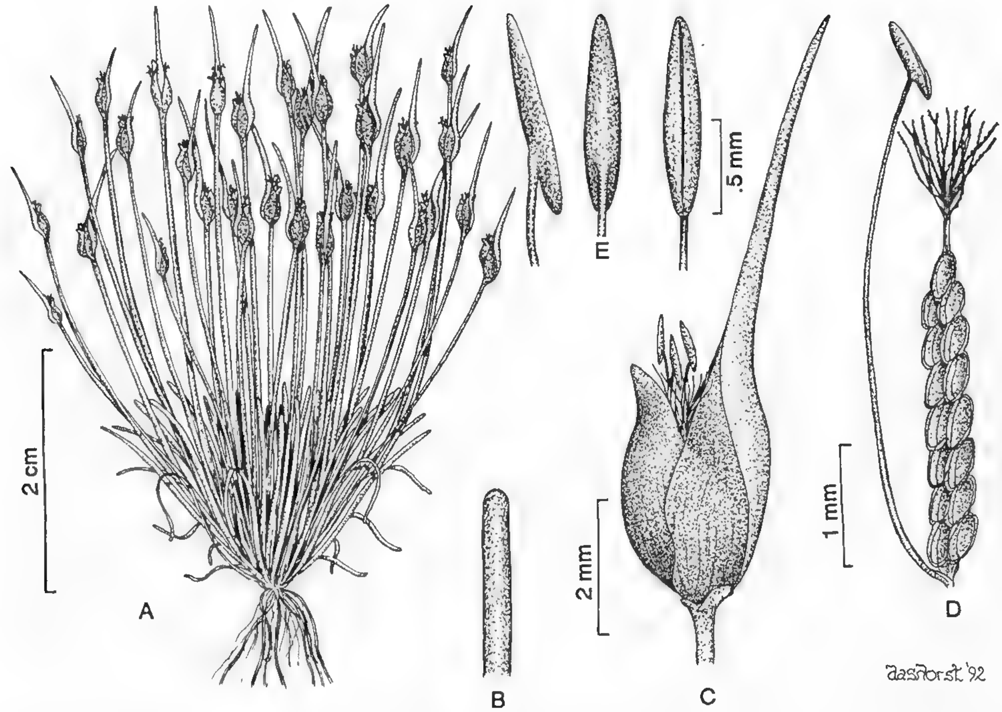


Fig. 17. *Centrolepis eremica.* A, habit; B, leaf apex; C, head; D, pseudanthium; E, anther, three views. (Based on *A.G. Spooner 73*: AD).

Ecology

Annual, growing during the wet season. Associated with temporary water on the margins of creeks, lakes, claypans or large boulders producing runoff. *Flowers* in July to September.

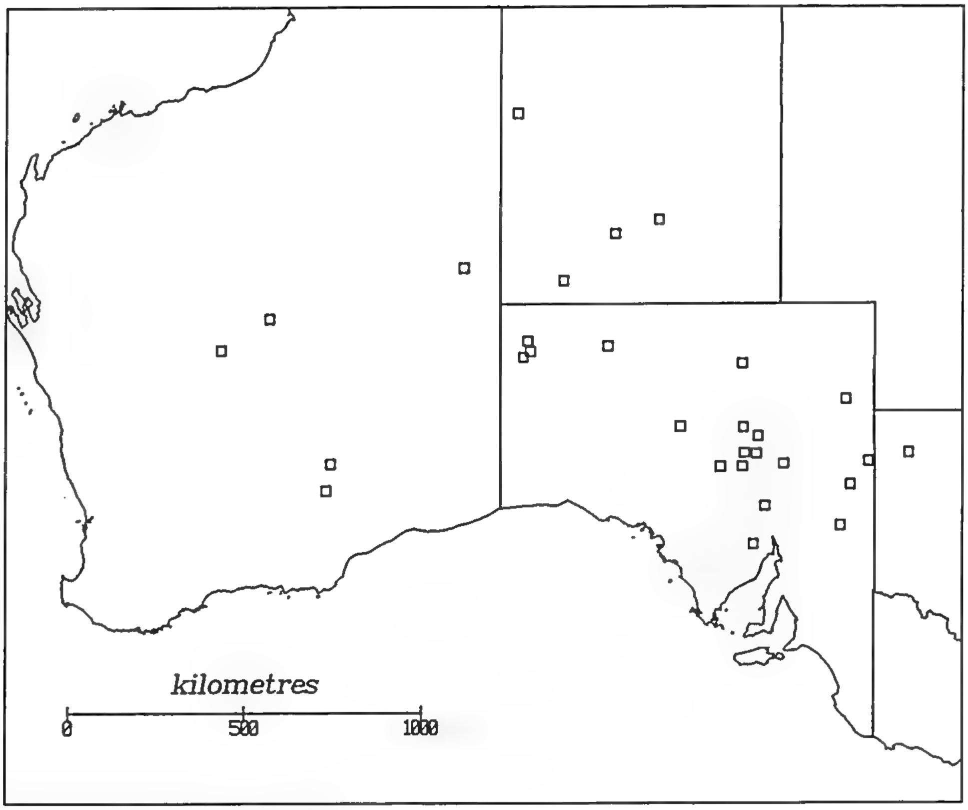
Notes

Close to *C. polygyna* from which it is separated by the broader ovoid-conic heads containing more numerous pseudanthia with free or absent stamens. These differences remain distinct in regions such as northern Eyre Peninsula where the two species are parapatric. The denser habit of *C. eremica* is a consequence of the production of successive inflorescences after the first have set seed. These two species form, with *C. cephaloformis* and *C. humillima*, a group characterised by one-veined and very unequally developed primary bracts and a rigid "sclerophyllous" texture due to the development of sclereid fibres in the leaves and bracts.

Selected specimens examined (total 38)

WESTERN AUSTRALIA: Beru Pool, Yelma Station, 5.ix.1973, *Chinnock 753* (AD; PERTH); Queen Victoria Spring, 21.ix.1963, *George 5861* (PERTH); Wallaroo Rock 72 km NW Coolgardie, 17.ix.1981, *Newbey 8936* (PERTH); Yeelirrie Station, 1982, *Trudgen s.n.* (MEL).

NORTHERN TERRITORY: Ayers Rock, 14.viii.1959, *Jackson 114* (AD); S of Mongrel Downs Station, 5.viii.1976, *Latz 6552* (NT, PERTH); Conlins Lagoon, vii.1894, *Tate s.n.* (AD); Palm Creek, vii.1894, *Tate s.n.* (AD).



Map 16. Distribution of *Centrolepis eremica.*

SOUTH AUSTRALIA: Christmas Water, Simpson Desert, 1961, *Ashton s.n.* (AD); South Corunna Hill, 8.ix.1974, *Chinnock 2014A* (AD); Mt Carmeena, Everard Ra., 15.ix.1963, *Eichler 17532* (AD); Coongie Lakes, 28.ii.1987, *Reid 438* (AD 98715308); SE arm of Lake Frome, 24.viii.1971, *Weber 2114* (AD).

NEW SOUTH WALES: Cobham Lake, n.d., *Bäuerlen 271* (MEL).

17. **Centrolepis polygyna** (R. Br.) Hieron., Abh. Naturf. Ges. Halle 12:210 (1873); F. Muell., Fragm. Phyt. Aust. 8:237 (1874); Benth., Fl. Austral. 7:203 (1878); Bailey, Queensl. Fl. 6:1719 (1902); Rodway, Tasm. Fl. 231 (1903); J. Black, Fl. S. Aust. 1:10 (1922); Ewart, Fl. Vict. 261 (1931); J.H. Willis, Handb. Pl. Vict. 1:278 (1962); Cooke in Jessop & Toelken, Fl. S. Aust. 4:1827 (1986).

Alepyrum polygynum R. Br., Prodr. 253 (1810), basionym.; Roemer & Schultes, Syst. Nat. 1:44 (1817); Desv., Ann. Sci. Nat. (Paris) 13:42 (1828); Nees in Lehm., Pl. Preiss. 2:71 (1846); J.D. Hook., Fl. Tasman. 2:78 (1860).

Type: banks of Oyster Harbour, King Georges Sound [W.A.], xii.1801, *Brown* sub Bennett No.5834 (Holo.: BM!).

Alepyrum polygamum Kunth, Enum. Pl. 3:488 (1841); Steudel, Syn. Pl. Glum. 2:266 (1855), sphalm. orthog.

Alepyrum pumilio R. Br., Prodr. 253 (1810); Roemer & Schultes, Syst. Nat. 1:44 (1817); Desv., Ann. Sci. Nat. (Paris) 13:42 (1828); Kunth., Enum. Pl. 3:488 (1841); Steudel, Syn. Pl. Glum. 2:266 (1855).

Type: Oyster Harbour, King Georges Sound [W.A.], xii.1801, *Brown* sub Bennett No. 5835 (Holo.: BM!).

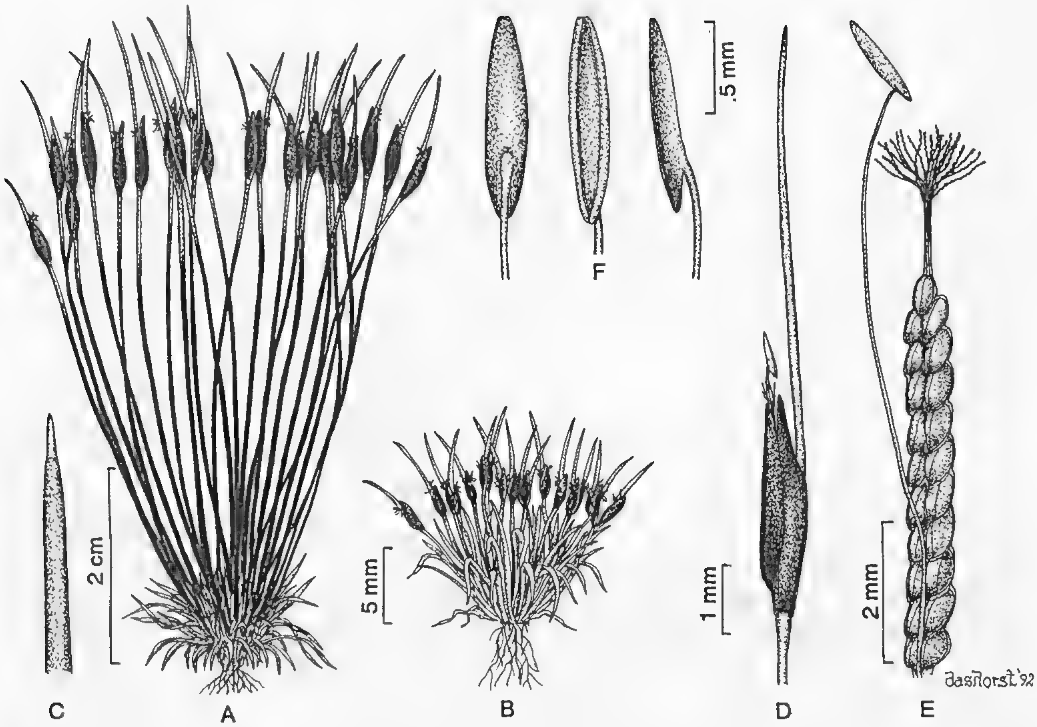


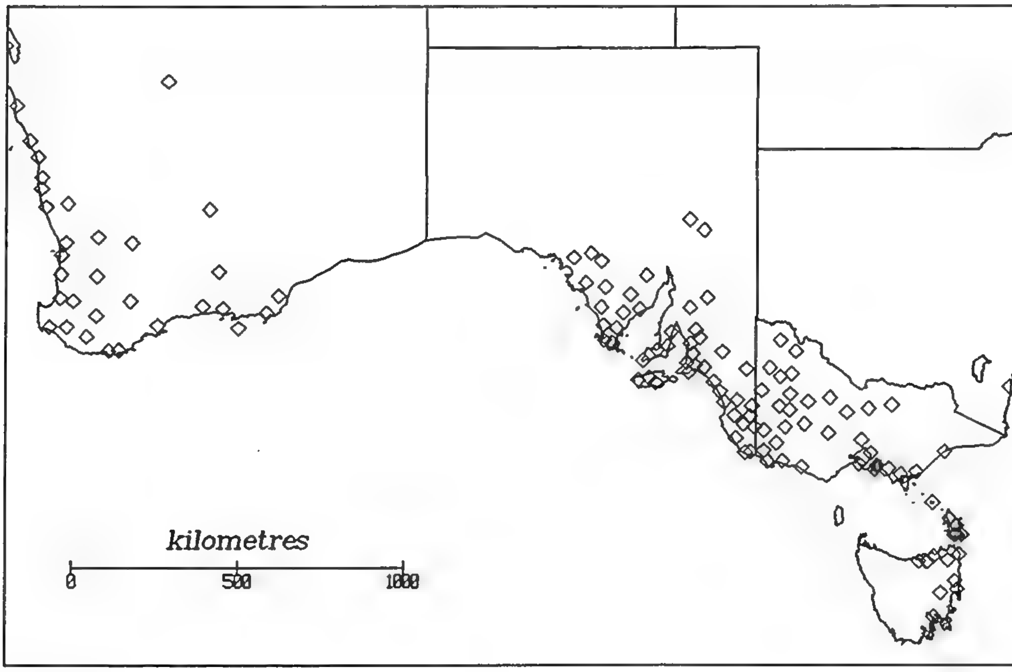
Fig. 18. *Centrolepis polygyna.* A, habit; B, habit; C, leaf apex; D, head; E, pseudanthium; F, anther, 3 views. (Based on *D.A. Cooke 403*: AD).

Tufted annual 1-7 cm high, rigidly herbaceous, becoming purplish after flowering. *Roots* numerous, hardly branched. *Stem* repeatedly branching from the lower axils, forming internodes of negligible length. *Leaves* few to many, not distichous, glabrous; sheath 1-5 mm long, scarious-hyaline, passing into a recurved or erect terete linear lamina 3-12 mm long, 0.5-0.8 mm wide; apex acute with a hyaline mucro or rarely obtuse. Uppermost leaf reduced to an obtuse veinless glabrous scarious cataphyll 1.5-3.5 mm long. *Scape* terete, up to 6 cm long, capillary, glabrous; rarely reduced and the head subsessile. *Head* cylindric or slightly compressed laterally, 0.7-1 mm wide. *Primary bracts* opposite, rounded on the back, glabrous, closely sheathing; outer bract with a brown cartilaginous 1-veined sheath 2-4.2 mm long passing abruptly into a ± recurved lamina 3-20 mm long; inner bract 2-4 mm long, acute, brown cartilaginous, lacking a lamina. *Secondary bracts* absent or rarely 1, acute, up to 1.8 mm long, brown, scarious. *Pseudanthia* 1-3, bisexual. *Stamen* adnate to the gynophore for 0.5-1 mm; filament capillary, 2.2-4.8 mm long; anther ellipsoid, 0.5-1.5 mm long. *Gynoecium* of 6-30 carpels; styles 1.4-2.6 mm long, connate at the base, pale brown; stigmatic papillae simple, c. 0.03 mm long. *Seed* ovoid, 0.5-0.8 mm long; testa smooth, stramineous. Fig. 18.

Distribution (Map 17)

Western Australia: widespread in the Irwin, Avon, Darling, Roe, Eyre and Coolgardie botanical districts. *South Australia*: widespread in southern areas, extending to Eyre Peninsula and the Flinders Ranges. *New South Wales*: occasional in the Central and Southern Western Slopes subdivisions. *Victoria*: widespread in the western half of the State; in the east infrequent on the coast and northern slopes of the Dividing Range. *Tasmania*: north and east coasts and the islands of Bass Strait.

Records from Central Australia (Tate, 1896; Jessop, 1981) are all referable to *C. eremica.*



Map 17. Distribution of *Centrolepis polygyna.*

Ecology

Winter annual of woodland, open forest, heath, scrub, moss beds, lake margins and mallee on sands and other infertile soils, where often growing with other *Centrolepis* spp. such as *C. strigosa. Flowers* in July to November.

Notes

C. polygyna is a variable species comprising many biotypes loosely associated with particular regions and habitats. For example, material from the Victorian mallee with two pseudanthia per head and a compact habit superficially resembling depauperate *C. eremica* was given the manuscript name var. *biflorum* by H.B. Williamson. Large, darkly pigmented plants with 2-3 pseudanthia per head are typical of south-western Victoria and the jarrah forests of Western Australia. Reduced states from Victoria and Tasmania resemble *C. cephaloformis* in their sessile heads (Cooke, 1980). An analysis of the variation in size, leaf apex, degree of purplish anthocyanin pigmentation, pseudanthia number, presence/absence of scape and presence/absence of a secondary bract showed no clear correlation among these characters, and recognition of infraspecific taxa is not justified.

Selected specimens examined (total 236)

WESTERN AUSTRALIA: Mt Chudalup, 9.x.1966, *Bennett 1603* (PERTH); Pallarup Rocks, 13.x.1960, *George 1568* (PERTH); Nambung National Park, 12.x.1978, *Spencer 15* (MEL); Tutanning Reserve, 16.xi.1965, *Wilson 3923* (PERTH).

SOUTH AUSTRALIA: Pondalowie, Innes National Park, 12.x.1974, *Alcock 4902* (AD); Granite Hill, 28.viii.1983, *Bates 3228* (AD); West Bay, Flinders Chase, 15.xi.1958, *Eichler 15515* (AD); Rowland Flat, 30.x.1978, *Keane 145* (AD).

NEW SOUTH WALES: Hastings River, n.d., *Beckler s.n.* (MEL).

VICTORIA: Mt Arapiles, 23.xi.1964, *Beauglehole 15891* (MEL); Kiata Lowan Sanctuary, 3.xi.1978, *Cooke 209* (MEL); Wartook, 5.xi.1978, *Cooke 253* (MEL); Quail Island, 22.xi.1952, *Melville 2085* (MEL).

TASMANIA: Bridport, 10.xi.1952, *Curtis s.n.* (HO); Moulting Lagoon, 7 miles NW of Coles Bay, 14.x.1967, *Hemsley 6255* (HO); Pot Boil Lagoon, Flinders Island, 15.i.1977, *Whinray 1529* (AD).

18. **Centrolepis humillima** F. Muell. ex Benth., Fl. Austral. 7:203 (1878); Diels & Pritzel, Bot. Jahrb. Syst. 35:95 (1904); Blackall & Grieve, West. Aust. Wildfl. 1:59 (1954); Cooke, Muelleria 4:270 (1980).

Type: Salt lagoons north of Stirling Range [W.A.], x.1867, *Mueller s.n.* (Holo.: K, n.v.; iso.: MEL 536059!, MEL 536060!).

Minute densely tufted annual, 4-10 mm high, coriaceous, forming dense colonies. *Roots* numerous, sparsely branched. *Stem* repeatedly branching from the lower axils to form internodes less than 0.3 mm long. *Leaves* few, obscurely distichous, glabrous; sheath brown, scarious, 0.8-2 mm long, passing into a rigid recurved broad-linear lamina 2-8 mm long, 0.5-1 mm wide, keeled, conduplicate towards the base; apex obtuse to acute, emucronate. Uppermost leaf reduced to an acute veinless scarious cataphyll. *Scape* absent. *Head* sessile or terminating internodes less than 0.4 mm long, laterally compressed, subcylindric, 0.5-1 mm wide. *Primary bracts* subopposite, glabrous, 1-veined, tightly enclosing the head; outer bract with a dark brown, strongly keeled, indurated sheath 1.5-3.5 mm long passing abruptly into a leaf-like lamina 2-5 mm long; inner bract 1-2.2 mm long, scarious to indurated with hyaline margins, conduplicate, the base exposed and often swollen, the apex acute and enclosed by the outer bract. *Secondary bracts* absent. *Pseudanthium* 1, bisexual, in the axil of the outer bract. *Stamen* free; filament capillary, 1.5-3.5 mm long; anther ellipsoid, 0.6-1.2 mm long. *Gynoecium* of (1)-3-7 carpels; styles 1.5-2.5 mm long, connate for less than half their length, pale brown. *Seed* ovoid, c. 0.5 mm long; testa regularly pusticulate, pale brown to white. Fig. 19.

Distribution (Map 18)

Western Australia: scattered in the Avon, Darling, Roe and Eyre botanical districts of the south-west between the 300 and 1000 mm annual isohyets.

Ecology

Winter annual of seral communities with sparse vegetation cover, often subject to water stress or low fertility, such as lithoseral moss beds and the margins of clay pans. *Flowers* in September to December.

Selected specimens examined (total 16)

WESTERN AUSTRALIA: 18 km E of Piawanning, 26.viii.1965, *Beauglehole 12254* (MEL); Natural Bridge, Albany, 11.ix.1965, *Beauglehole 12705* (MEL); Neridup, 21.ix.1968, *Eichler 19912* (AD; PERTH); Martin Creek, 7.ix.1971, *Eichler 21077A* (AD); Eyre Hwy 12.5 km SSE Salmon Gums, 12.xi.1971, *Eichler 21245* (AD); Martin Creek, 34°04'S 119°27'E, 7.ix.1971, *George 10937* (PERTH); Spring Creek, 3.x.1986, *Newbey s.n.* (PERTH);

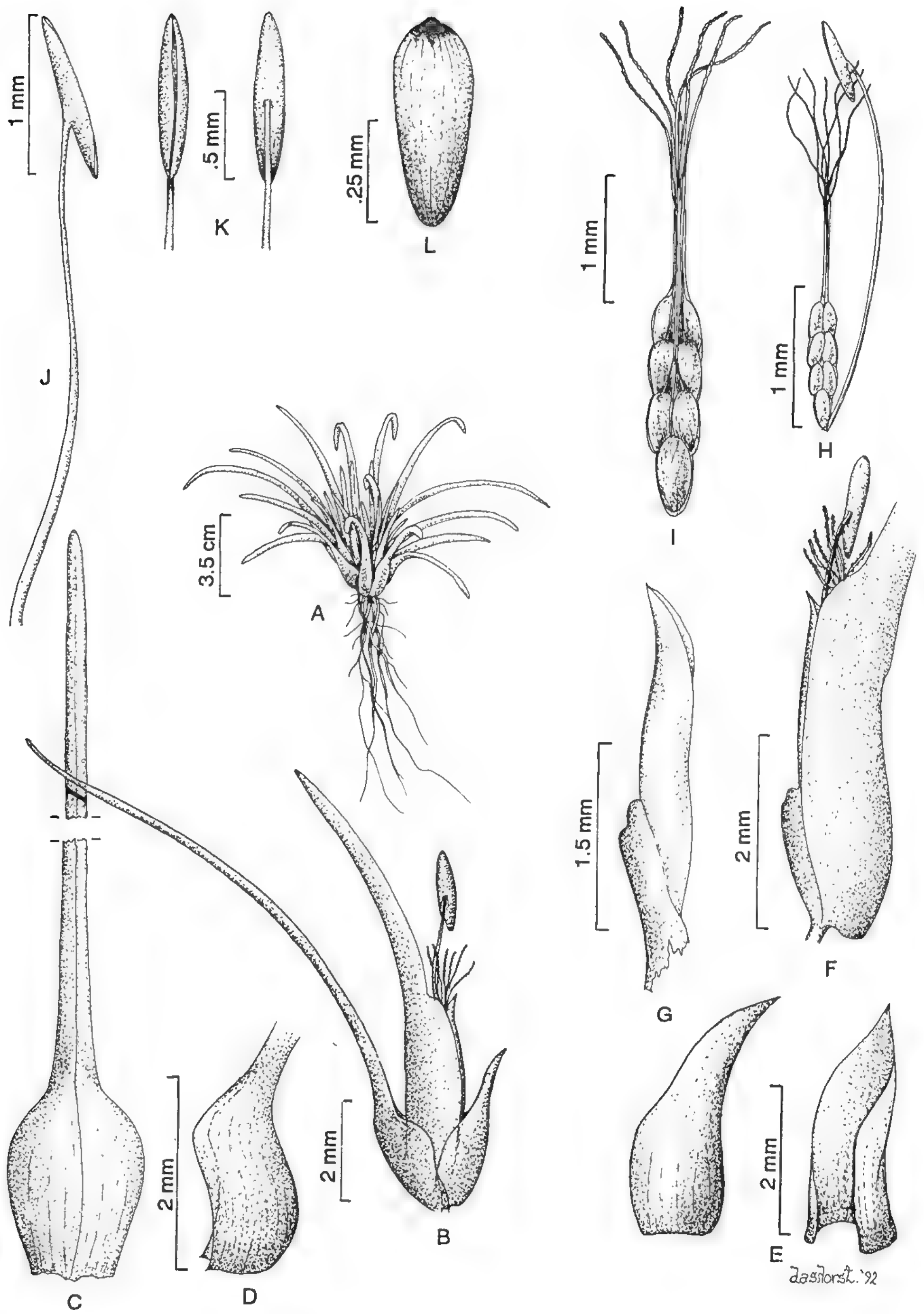
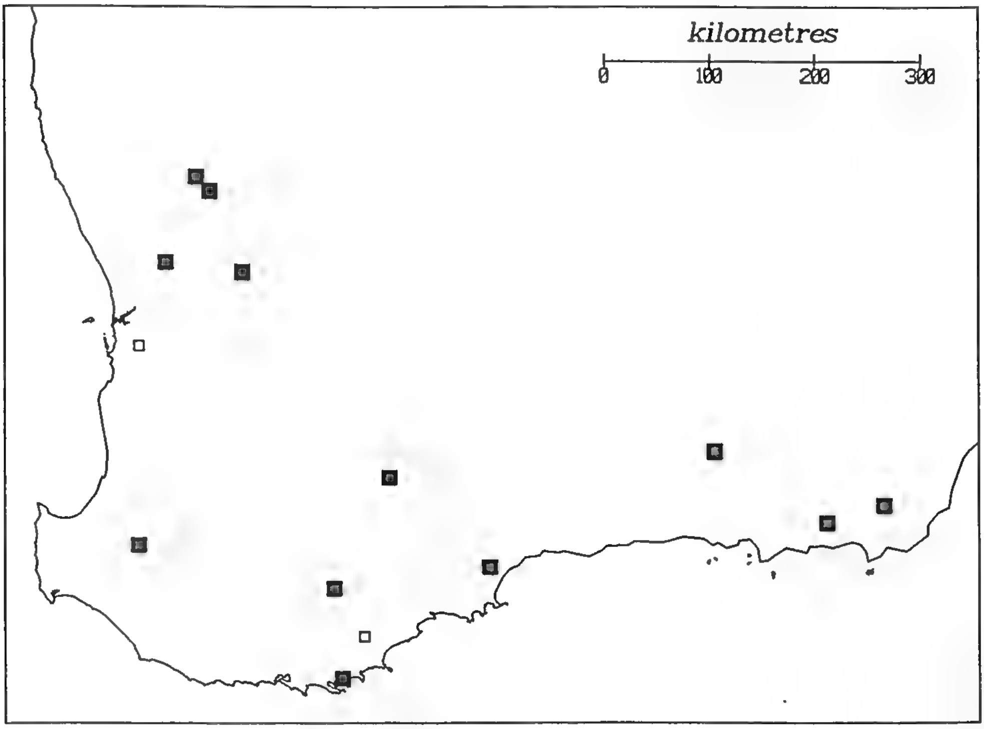


Fig. 19. *Centrolepis humillima.* A, habit; B, head, leaf and cataphyll; C, leaf; D, base of leaf, lateral view; E, cataphyll, two views; F, head; G, inner primary bract; H, pseudanthium; I, gynoecium; J, stamen; K, anther, two views; L, seed. (Based on *Hj. Eichler 21245*: AD).

Balladonia Road, Cape Arid N.P., 5.xii.1971, *Royce 10153* (PERTH); Wongan Hills, 17.ix.1963, *Willis s.n.* (MEL); Lake Grace road, 28 km N of Pingrup, 12.x.1979, *K. Wilson 2767* (NSW); Mortlock R. flats 4 km E of Meckering, 11.viii.1982, *P. Wilson 11839* (MEL; PERTH).



Map 18. Distribution of *Centrolepis humillima* ■ and *C. caespitosa* □.

19. **Centrolepis cephaloformis** F.M. Reader, Vict. Naturalist 19:97 (1902); Ewart, Fl. Vict. 260 (1931); J.H. Willis, Handb. Pl. Vict. 1:278 (1962); Cooke, Muelleria 4:267 (1980); Cooke, Fl. S. Aust. 4:1826 (1986).

Type: Sandy desert, Lowan [Vic.], 1892, *F.M. Reader s.n.* (Lecto.: MEL 536054, pro parte!; syn.: MEL 536054, pro parte!; MELU 11831!).

Dwarf annual 4-10 mm high, rigidly herbaceous, forming compact rounded tufts 4-32 mm diam. *Roots* numerous, hardly branched. *Stem* repeatedly branching from the lower axils to form internodes less than 1 mm long. Leaves few, not distichous, glabrous; sheath 1-2.5 mm long, scarious, passing into a ± recurved subulate lamina 2-6 mm long, 0.5-0.8 mm wide; apex acute with a hyaline mucro. Uppermost leaf reduced to a cataphyll. *Scape* absent or represented by an internode to 3 mm long. *Head* ovoid-conic, 1-1.7 mm wide, 2-3 mm long. *Primary bracts* opposite, keeled, glabrous, closely sheathing; outer bract with a scarious, stramineous, 1-veined sheath 2-3 mm long passing abruptly into a lamina 2-4.5 mm long; inner bract 2-3 mm long, acute or apiculate, scarious, lacking a lamina. *Secondary bracts* absent. *Pseudanthia* 1-3, bisexual or one lacking the stamen. *Stamen* free; filament capillary, 2-4 mm long; anther ovoid-ellipsoid, 0.5-1.4 mm long. *Gynoecium* of 4-10 carpels; styles 1-2 mm long, connate for half their length, pale brown; stigmatic papillae simple, c. 0.03 mm long. *Seed* ovoid, 0.4-0.6 mm long; testa smooth, stramineous.

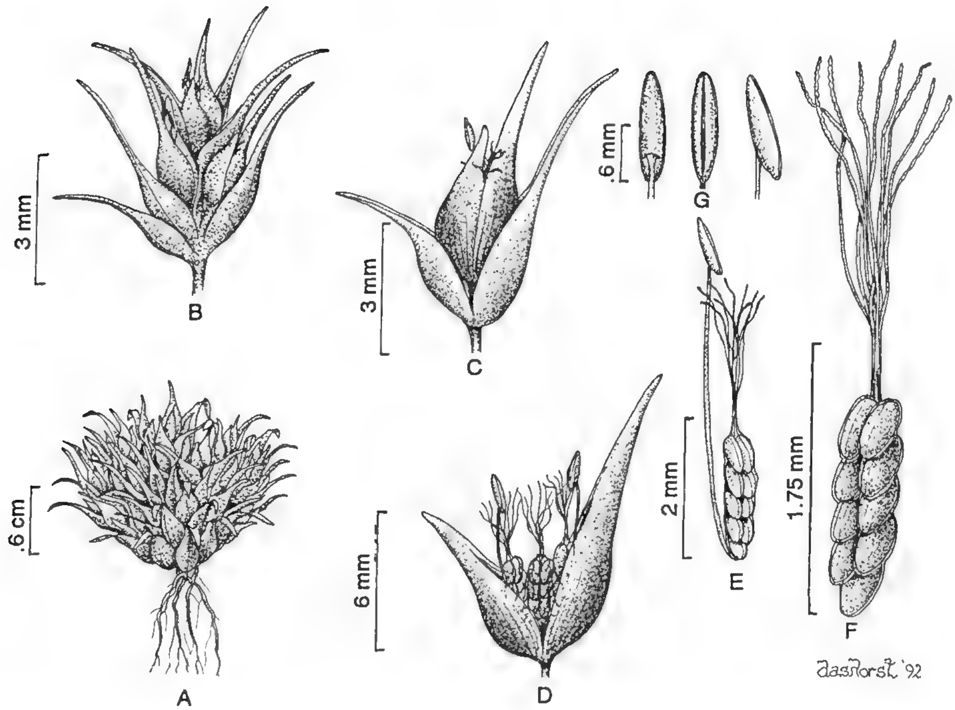


Fig. 20. *Centrolepis cephaloformis* subsp. *cephaloformis*. A, habit; B, branch; C, head with leaf and cataphyll; D, head, opened; E, pseudanthium; F, gynoecium; G, anther, 3 views. (Based on *D. Blackburn BI 55*: AD).

Key to subspecies

All or most heads containing three pseudanthia, two bisexual and the third lacking the stamen; cataphyll obtuse. .... 19a. subsp. *cephaloformis*

All or most heads containing a single bisexual pseudanthium; cataphyll acute.......... 19b. subsp. *murrayi*

19a. subsp. **cephaloformis.**

Laminae of leaves and outer primary bracts manifestly recurved, subequal to the sheath in each case. *Cataphyll* obtuse, veinless, never bearing a lamina. *Head* containing 3 pseudanthia, 2 bisexual and the third lacking the stamen (rarely one of the bisexual pseudanthia absent in reduced heads). Fig. 20.

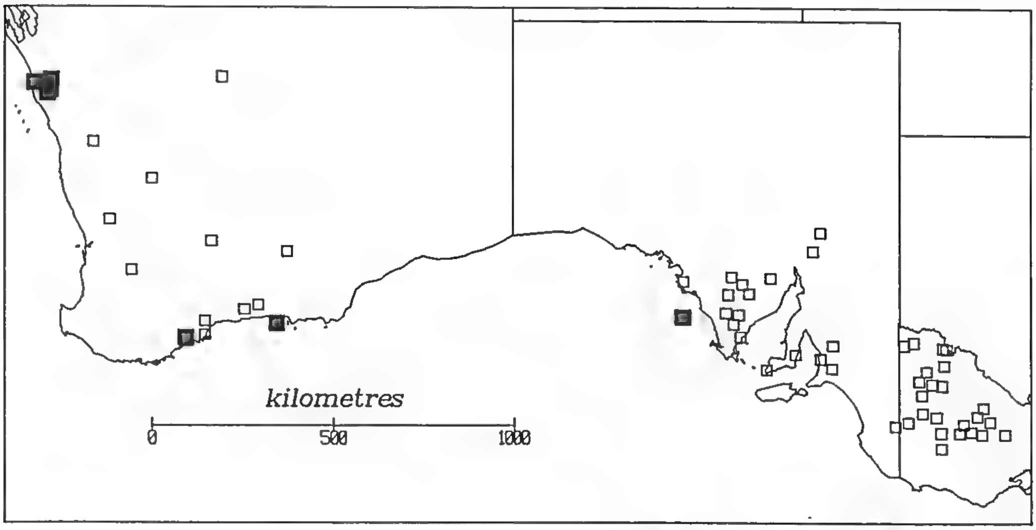
Distribution (Map 19)

Western Australia: scattered in the Darling, Avon, Irwin and Eyre botanical districts of the south-west. *South Australia*: widespread on Eyre Peninsula, Yorke Peninsula and the Murray Mallee; more localised in the Mt Lofty and southern Flinders Ranges and the lower south-east. *Victoria*: widespread west of Bendigo, extending from Hattah Lakes south to the northern Grampians.

Ecology

A winter annual of seral communities with sparse vegetation cover, often subject to water stress or low fertility, such as dunes and the margins of clay pans and salt marshes.

Flowers in September to October. The whole fruiting plant may become detached from the dry substrate in summer and be dispersed as a burr on the fur of animals; the rigid, recurved leaves and bracts appear to be an adaptation for dispersal. It is unusual among the scapeless *Centrolepis* in its relatively ruderal strategy with high seed production (Table 1.)



Map 19. Distribution of *Centrolepis cephaloformis* subsp. *cephaloformis* and subsp. *murrayi* .

see text

Selected specimens examined (total 61)

WESTERN AUSTRALIA: Dundas Rocks, 18.ix.1965, *Beauglehole 13125* (MEL); Martin Creek, 7.ix.1971, *Eichler 21077B* (AD); Oldfield River crossing, Eyre Hwy, 10.ix.1971, *Eichler 21176* (AD); Split Rocks 95 km SSE of Southern Cross, 6.x.1981, *Newbey 9262* (PERTH).

SOUTH AUSTRALIA: Oak Amphitheatre, Hincks N.P., 6.x.1968, *Alcock 2258* (AD); Granite Hill, 33°10'S 136°10'E, 28.viii.1983, *Bates 3227* (AD); Torrens Island, 1.xii.1984, *Blackburn B155* (AD); South Corunna Hill, 8.ix.1974, *Chinnock 2024* (AD); Mt St. John, Wilpena, 15.ix.1978, *Symon s.n.* (AD).

VICTORIA: Little Desert National Park, 3.xi.1978, *Cooke 228* (MEL); Ironstone Hill, 3 miles N of Bendigo, 3.x.1952, *Melville 1393A* (MEL); 2 km NW of Wonga Hut, Wyperfeld, 5.ix.1978, *Muir 5895* (MEL); 8 miles S of Hattah, x.1968, *Noy-Meir 1959* (CANB).

19b. subsp. **murrayi** (J. Black) D. Cooke, Muelleria 4:269 (1980); Fl. S. Aust. 4:1826 (1986).

Centrolepis murrayi J. Black, Trans. R. Soc. S. Aust. 47:367-368 (1923), basionym; Fl. S. Aust. 1:179 (1943); Jessop, Fl. S. Aust. 1:315 (1978).

Type: Hill 781, North Pearson Island, South Australia, i.1923, *T.G. Osborn s.n.* (Holo.: AD 96012011!; iso.: AD 97918146, pro parte!).

Laminae of leaves and outer primary bracts recurved to straight, exceeding the sheath in each case. *Cataphyll* acute, sometimes with a distinct vein and a much-reduced leaf lamina. *Head* containing a single bisexual pseudanthium (very rarely a second pseudanthium present and lacking the stamen).

Distribution (Map 19)

Western Australia: on the west coast near Kalbarri, Beaufort Inlet and in the Recherche Archipelago. *South Australia*: Pearson Islands.

Ecology

Winter annual, *flowering* in August to October.

The habitat of the type collection was stated on the label and by Black (1923) to be *Casuarina* forest, further specified by Osborn (1923) as drainage channels near bare granite slopes; the soil surface was covered by *Ulothrix* filaments, indicating inundation by winter runoff. This *Centrolepis* was not rediscovered during extensive collecting on the Pearson Islands in February 1960 (Specht, 1969) nor among plants germinated from soil samples collected at this time (Symon, 1971). The Western Australian collections are from semi-arid *Banksia - Acacia - Eucalyptus* scrub heath of the Kalbarri system (Beard, 1976) on sandplains near the Murchison River, from saline soil near the Pallinup River mouth, and from soakages around granite boulders on Boxer Island. All habitats have a summer water deficit, with an annual rainfall usually between 300 and 500 mm.

Conservation status

Despite its rarity, a risk code of 3VC is assigned as the populations are widely scattered and represented on reserved offshore islands.

Specimens examined

WESTERN AUSTRALIA: 14.5 km W of Kalbarri turnoff from coast Hwy, 23.viii.1965, *Beauglehole 12063* (MEL); Geraldine mine, Murchison River, 14.viii.1983, *Burns 36* (PERTH); 2 miles [3 km] W of Eurardy Homestead, N of Murchison River, 24.viii.1969, *George 9526* (PERTH); Beaufort Inlet, 1987, *K. Newbey s.n.* (PERTH); Boxer Island, Recherche Archipelago, 8.xi.1950, *Willis s.n.* (MEL; PERTH); 4.5 km N of Kalbarri, 29.ix.1979, *Wilson 2640* (NSW).

SOUTH AUSTRALIA: raised from seed of Type at University of Adelaide, x.1923, *Osborn s.n.* (AD).

20. **Centrolepis caespitosa** D.A. Cooke, Muelleria 4:269-270 (1980); Rye in Marchant et al., Fl. Perth Reg. 2:924 (1987).

Type: Beenup [Byford], W.A., 26.xi.1904, *A. Morrison s.n.* (Holo.: PERTH!).

Small densely tufted annual, softly herbaceous, forming hemispherical cushions to 2.5 cm diam. *Roots* numerous, hardly branched. *Stem* repeatedly branching from the lower axils, forming internodes 0.4-2 mm long. *Leaves* numerous, crowded, glabrous; sheath 0.8-2 mm long, scarious-hyaline, passing into a straight linear terete lamina 5-9 mm long, c. 0.2 mm wide, dark-pigmented in dried material; apex subacute, emucronate. Uppermost leaf reduced to an acute veinless scarious cataphyll 1-2 mm long. *Scape* absent. *Head* terminal on internodes 1-2 mm long, terete, cylindric with a prominent oblique node at the base, c.

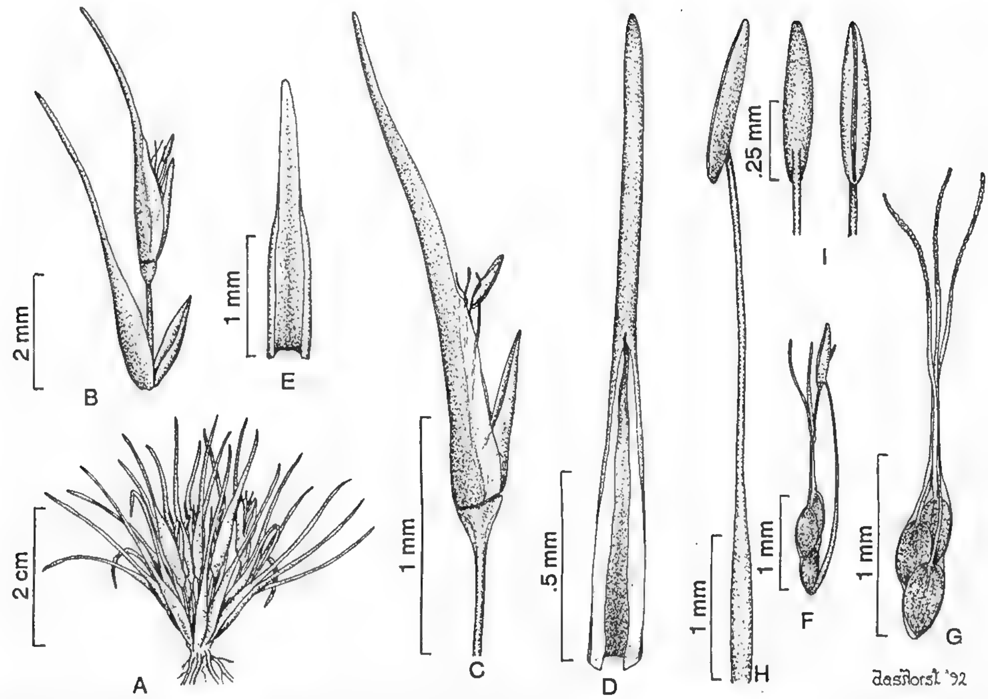


Fig. 21. *Centrolepis caespitosa.* A, habit; B, branch; C, head; D, outer primary bract; E, inner primary bract; F. pseudanthium; G, gynoecium; H, stamen; I, anther, two views. (Based on *G.J. Keighery 917*: PERTH).

0.5 mm wide. *Primary bracts* opposite, glabrous, closely enclosing the head; outer bract with a keel-less 3-veined scarious-hyaline sheath 1.5-3 mm long passing gradually into a leaf-like lamina 2.5-4 mm long; inner bract keeled, 1-veined, 1.5-2 mm long, almost wholly hyaline with a recurved herbaceous apex to 0.6 mm long. *Secondary bracts* absent. Pseudanthium 1, bisexual. *Stamen* free; filament capillary, 3-4 mm long; anther oblong-ellipsoid, 0.5-0.7 mm long. *Gynoecium* of (2)-3-6 carpels; styles 1-2 mm long, connate for one-third to half their length, pale. *Seed* ovoid, c.0.4 mm long; testa smooth, stramineous. Fig. 21.

Distribution (Map 18)

Western Australia: recorded from two disjunct localities in the Perth-Albany region.

Ecology

Has been found on open wet clay soil; both localities are in the 700-900 mm annual rainfall zone. *Flowering* is recorded in November.

Conservation status

Although classed as extinct by Briggs & Leigh (1988), the actual distribution and abundance of this species are uncertain. It is presumed to be rare, and has not yet been collected from any nature reserve.

Notes

C. caespitosa superficially resembles the preceding two scapeless species in habit, but its 3-veined outer primary bract and herbaceous texture suggest that it does not belong in this group of species around *C. polygyna.*

Specimens examined

WESTERN AUSTRALIA: 10 km S of South Stirlings townsite, 10.xi.1976, *Keighery 917* (PERTH); Beenup, 26.xi.1904, *A. Morrison* (PERTH).

Nomen dubium

Centrolepis videns J. Stirling, Trans. & Proc. Bot. Soc. Edinburgh 22:379 (1903), nom. nud.

This species was recorded from the Australian Alps to 4,000' altitude (Stirling, loc. cit.). The etymology of the epithet is obscure, and it may be a misprint for *virens*, evergreen. The same publication lists *C. aristata* and *C. strigosa* for the same region; as the only other *Centrolepis* known from the Victorian Alps is the evergreen perennial *C. fascicularis*, *C. videns* is likely to be a synonym of this species.

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ESTABLISHING NATIVE PLANTS IN THE ARID ZONE

G.S. Dalton

Woods and Forest Department, PO Box 752
Murray Bridge, South Australia 5253

Abstract

Thirteen establishment techniques were tested to determine the effect of weed control, watering frequency and mulches on survival and early growth of tree seedlings in an arid zone near Port Augusta.

Fortnightly watering and residual weed control for a 3m diameter circle were found to be the two most important factors, while organic and bitumen mulches were contributing no advantage. Bi-monthly watering was found to be insufficient. Removal of weed competition at planting, without any residual weed control, was of no major benefit, and residual weed control over a 1m diameter circle was also of no benefit.

While the advantages of weed control were shown in this work the above average rainfall for the period of the trial suggests that the work should be repeated in a more representative year before the weed control techniques can be confidently used.

Introduction

An arid zone has been defined as an area with 150-300mm/annum rainfall (Meigs 1953, cited by Hall et al. 1972), and on this basis 76.3% of South Australia is arid zone.

Tree planting in arid zones can be difficult due to the lack of available moisture during the establishment phase. Seedlings are usually watered as rainfall is so irregular or, where there is a sloping site with sufficient clay in the soil, water-harvesting techniques can be used (Wilson 1980). On flat sandy sites water-harvesting is not an option so that watering becomes the standard practise. Hall et al. (1972) state that watering of newly planted shrubs and trees is usually essential to ensure successful establishment in arid zones and they suggest weekly watering for at least six months. Zwar (personal communication, 1986) successfully established hundreds of plants at Port Augusta (see site description below) by fortnightly watering of 40-50 litres. Sandell et al. (1986) achieved successful establishment by weekly watering with 20 litres of water for the first month, then once per fortnight for a further six months.

Another way of increasing available moisture to seedlings is by removing weed competition. Hall et al. (1972) state that grass is usually so sparse in arid zones that competition is not serious, but they do not present any evidence to support this statement. Dalton (1987), working in 340 and 400mm/annum rainfall zones, found that after 12 months seedlings which did not receive supplementary watering but had the weeds controlled around them had 16-20 times the canopy volume of seedlings which didn't have weed control. In more extreme arid zones there may not be such a large growth conferred by weed control; the degree of advantage is not known. Nor is it known whether watering frequency can be reduced if weeds are controlled. Furthermore, optimum width of weed control around the seedling and the relative advantage of mulches in arid zone plantings is not known.

This paper reports on a trial in which the effect of weed control, watering frequency and mulches was investigated on survival and early growth of tree seedlings in an arid zone location near Port Augusta.

Materials and methods

The trial site was at the Australian Arid Lands Botanic Garden, Port Augusta, South Australia; latitude 32°32'24"; longitude 137°46'50"; altitude 4.34m; average maximum temperature 32°C; average minimum temperature 7.3°C; mean annual rainfall 257mm (Table 1); mean relative humidity (3p.m.) 38.6%; mean annual pan evaporation 2,500mm.

The soil is a deep red sand and the existing vegetation consisted of *Maireana sedifolia*, *Sclerolaena obliquicuspis*, *Atriplex holocarpa*, *Sida intricata*, *Carrichtera annua*, *Enneapogon avenaceus*, and a *Stipa* sp.

Tree seedlings were established using the treatments detailed in Table 2. All planting sites were disturbed with a post-hole digger to enable easy planting and basins large enough to hold 20 litres of water were made for the treatments which received watering (1-6). Organic mulch consisted of chopped-up leaves and small branches from prunings of various plant species. The dimensions 1m and 3m refer to clearance circles of 1m and 3m diameter, respectively. For all weed control treatments the appropriate areas were cleared of woody vegetation (eg: *Maireana* sp.) with hand tools because the action of knockdown herbicides on these species is not known.

After hand-clearing and planting a knockdown herbicide containing paraquat and diquat was applied at the rate of 400g/ha and 200g/ha, respectively, to all the herbicide treatments. To the residual weed control treatments oxyfluorfen at 720g/ha and oryzalin at 3kg/ha was also applied. For all herbicide spraying the planted seedlings were protected so that no herbicide contacted their foliage. Herbicides were applied using a knapsack sprayer with a water output of 300 l/ha. The bitumen was mixed as 1 part to 20 parts of water and sprayed onto the soil surface to create a thin film.

	Post Office	Power Station	
	Average for 1860-1962	Average for 1958-1983	1986/87 Totals
July	20	22	74.4
August	23	21	49.0
September	22	23	14.2
October	23	29	56.1
November	18	19	13.0
December	16	14	6.4
January	15	22	61.4
February	17	23	45.8
March	17	10	19.2
April	19	16	2.8
May	26	31	50.4
June	27	27	20.4
Annual	**243**	**257**	**413.1**

Table 1. Port Augusta rainfall records in mm showing long term monthly averages and monthly totals for the year of the trial (1986/87)

Seedlings were planted on 27th August, 1986, after good July and August rains (Table 1). Because the soil was moist at planting the seedlings were not watered in. The organic mulch (30-60mm deep) and herbicide treatments were applied on 28th August, 1986, and the bitumen was applied on 3rd October, 1986. The *Sclerolaena* sp. quickly regenerated in the

residual weed control treatments and were hoed out on 10th December, 1986. Oxyfluorfen and oryzalin did not control the new germination of this species, and seedlings were removed because the concept of a weed free situation was being investigated, not herbicide efficacy.

Eucalyptus socialis and *Eucalyptus transcontinentalis* both occur in rainfall zones as low as 250mm/annum (Chippendale 1973, Costermans 1983) and were planted at 5m x 5m intervals, as single tree plots in a randomised complete block design of seven replicates for each species. On 18th June, 1987, seedling survival was counted, and the stem diameter 20-30mm above ground level, and height was measured for each seedling. A dead seedling was recorded as having a 'zero'diameter or height.

Results and discussion

(i) Survival

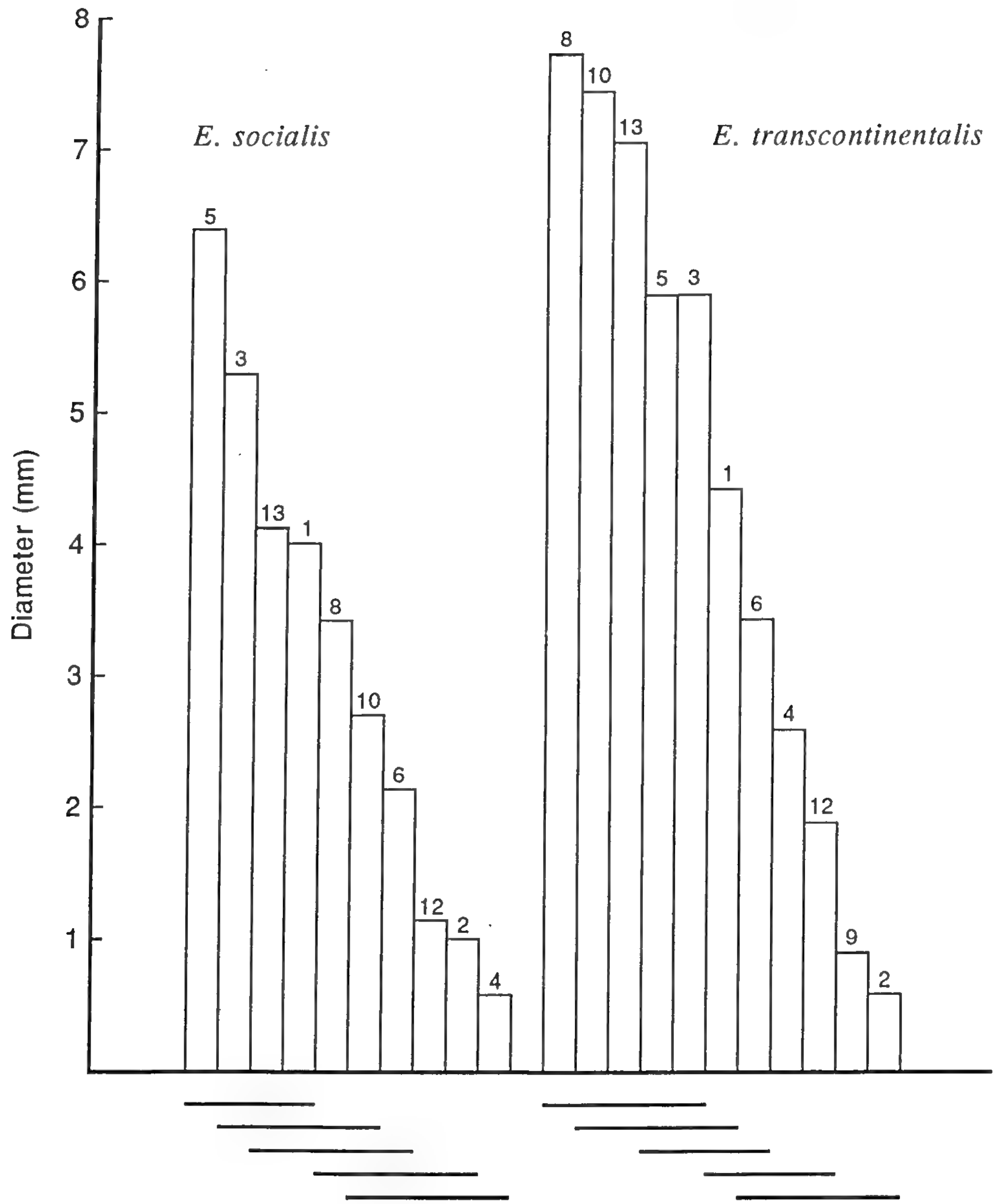
Survival counts are given in Table 2. A count of 6 or 7 was considered acceptable and lower counts unacceptable. Acceptable survival occurred with treatments which received fortnightly watering treatments (1,3 and 5) or had a 3m diameter residual weed control area (treatments 8, 10 and 13 for *E. transcontinentalis* and treatment 13 for *E. socialis*).

Number	Treatments	Number survived *E. socialis*	*E. transcontinentalis*
1.	Organic mulch, fortnightly watering	6	6
2.	Organic mulch, bi-monthly watering	2	1
3.	Fortnightly watering	7	7
4.	Bi-monthly watering	1	4
5.	Residual weed control 1m, fortnightly watering	7	6
6.	Residual weed control 1m, bi-monthly watering	3	5
7.	Organic mulch	0	0
8.	Organic mulch, residual weed control 3m	5	7
9.	Residual weed control 1m	0	2
10.	Residual weed control 3m	3	7
11.	No mulch, weed control or watering	0	0
12.	Knockdown weed control 3m, bitumen mulch 3m	2	5
13.	Residual weed control 3m, bitumen mulch 3m	6	7

Table 2. The thirteen establishment treatments tested for two species and the count (out of seven) of survival 10 months after planting.

With fortnightly watering treatments, acceptable survival was achieved without the mulch (1) or small weed control areas (5). This showed that if fortnightly watering is practised then mulches or small areas of weed control do not have to be used. If watering is less frequent than fortnightly, the benefit from the mulch and the small weed control area may become more apparent. However, the benefit is not sufficient to give acceptable survival when watering is reduced to bi-monthly (2, 6).

As seedlings were not watered in, the acceptable survival achieved with some of the 3m diameter weed control treatments was done without the seedlings receiving any watering at all. Treatments 8 and 10 for *E. socialis* did not have acceptable survival counts, but because of the advantage from weed control, it may be that with a few waterings at critical periods their survival counts would have been acceptable as they were for *E. transcontinentalis*. The



F9, 54 = 5.16, EMS = 5.0574

F10, 60 = 6.72, EMS = 7.1917

Fig. 1. Stem diameter, of two species, 10 months after planting, as affected by establishment technique (see Table 1). Treatments joined by the same line were not different (p = 0.05) using Duncan's multiple range test.

data suggests that 3m diameter weed control clearance and strategic waterings may be sufficient to achieve acceptable survival in arid zones; which is a cheaper technique than fortnightly watering.

Of the treatments which had unacceptable survival counts that with no mulch, weed control or watering resulted in the plants dying (11); bi-monthly watering was not frequent enough (discussed above); 1m diameter weed control clearance areas were inadequate (9); killing the weeds at planting (12) does not produce as good survival as keeping the soil weed-free (8, 10, 13).

(ii) Stem diameter

With all 13 treatments included, the Bartlett's test for homogeneity of variance showed that treatments had heterogeneous variances for both species. When treatments that had 100% mortality were excluded from the data (i.e. treatments 7, 9 and 11 for *E. socialis* and treatments 7 and 11 for *E. transcontinentalis*) homogeneity of variances existed (X 2/9 = 12.109 for *E. socialis* and X 2/10 = 12.57 for *E. transcontinentalis*) so an analysis of variance was performed on the data. The results are presented in Figure 1. Treatments not significantly different (p=0.05) from the highest mean are the group of best treatments, this group comprising treatments which had either fortnightly watering or a 3m diameter residual weed control clearance area.

The use of residual herbicides may not always be practical in arid zone situations because of the need for rainfall for their incorporation. However this work shows the importance of keeping the soil weed free which can be done by other means such as cultivation.

Table 1 shows there was above average rainfall for October 1986, January and February 1987, and for the total year of the trial. These falls may have increased growth, especially for the unwatered treatments, and the benefit of the 3m diameter residual weed clearance area control should be tested in a year with less rain before being recommended as a plant establishment technique.

		E. socialis	*E. transcontinentalis*
Organic mulch			
With fortnightly watering	(1 vs. 3)	X	X
With bi-monthly watering	(2 vs. 4)	X	X
With residual weed control 3m	(8 vs. 10)	X	X
Bitumen mulch			
With residual weed control 3m	(13 vs. 10)	X	X
Fortnightly vs. bi-monthly watering			
With organic mulch	(1 vs. 2)	G	G
With no mulch	(3 vs. 4)	G	G
With residual weed control 1mm	(5 vs. 6)	G	X
Weed control			
3m vs. 1m	(10 vs. 9)	G	G
Residual 3m vs. knockdown 3m	(13 vs. 12)	G	G

Table 3. Comparisons of stem diameter to determine the effect of individual factors. The comparisons are between treatments which differ only in the factor mentioned. (X = the two treatments did not produce significantly different growth; G: the former treatment produced significantly greater growth.)

Table 3 shows that there was no advantage derived from the organic or bitumen mulch and confirms the value of fortnightly watering and 3m residual weed control. The bitumen mulch may be of more benefit if the site is subject to sand drift and any mulch would be expected to be of more benefit on soils of high evaporative potential.

(iii) Plant height

For *E. socialis* the correlation co-efficient for stem diameter and plant height was $r(9)=0.990$, which is a significant correlation at $p<0.001$; and is described by the equation $y=1.2094 + 7.198X$; where y=height in centimetres and x=diameter in millimetres. For *E. transcontinentalis* the same correlation gave $r(10)=0.98$ (significant correlation at $p<0.001$) described by the equation $y=4.7612 + 5.9009X$. These correlations show that stem diameter was a good indicator of tree growth and useful for determining seedling heights for relating to other work.

Conclusion

This trial shows that residual weed control over a 3m diameter circle can give results comparable to those achieved with fortnightly watering. However, the rainfall was above average for the year of the trial so the advantage from the weed control needs to be evaluated in a more typical year with less rain. Nevertheless, there is an advantage from weed control and it is likely that the most economical establishment technique will be a combination of weed control with waterings during extended dry periods. This should be tested.

Of significance in terms of weed control are the facts that a 1m diameter circle of weed control is of negligible value; and that non-residual weed control will not give as much growth advantage as will be achieved by keeping the sites weed free.

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NEW AUSTRALASIAN SPECIES OF *PEPLIDIUM* AND *GLOSSOSTIGMA* (SCROPHULARIACEAE)

W.R. Barker

State Herbarium, Botanic Gardens, North Terrace, Adelaide, South Australia 5000

Abstract

Peplidium foecundum W.R.Barker from arid central and south-eastern Australia and *Glossostigma cleistanthum* W.R.Barker from central and south-eastern Australia and New Zealand are formally named and described.

Two species, respectively from the genera *Peplidium* and *Glossostigma*, are newly described to provide names for their treatment in the forthcoming *Flora of New South Wales* (Barker et al., in press). Both species occur in central and south-eastern arid Australia, but the *Glossostigma* extends into higher rainfall areas of south-eastern mainland Australia and to New Zealand. Their evolutionary relationships, adaptations and biogeography have been dealt with previously in a paper on the subtribe Mimulinae (Barker 1982). Attention is also drawn to the recent description of a new *Peplidium* in arid Australia (Barker 1990).

Peplidium foecundum W.R. Barker, *sp. nov.*

Microcarpaea/Peplidium sp. D: W.R. Barker, *Evolution Fl. Fauna Arid Austral.* (1982) 343-347.

P. sp. D: W.R. Barker in Jessop & Toelken, *Fl. S. Austral.* (1986) 1289, fig. 586C.

P. humifusum auct. non Delile: Tate, *Hdbk Fl. Extratrop. S. Austral.* (1890) 153, 253.

P. maritimum auct. non (L.f.)Asch.: J. Black, *Trans. R. Soc. S. Austral.* 57 (1933) 156.

Species nova speciebus staminibus duobus fructibusque indehiscentibus affinis; a *P. maritimo* (L.f.)Asch. (syn. *P. humifusum* Delile) differt fructibus seminibusque maioribus, a ceteris corollis e calyce vix exsertibus fructibusque abundantibus.

Holotypus: *W.R. Barker 3545*, 16.ix.1978, South Australia. Region 2: Lake Eyre Basin. Stuart Highway, ca. 46 km by road S of Coober Pedy (29°25'S 134°48½'E). Prolific, intermixed with *Peplidium* spp. (*Barker 3544, 3546*) and *Limosella curdieana*. Small claypan, dried out, in gibber plain; low open shrubland. Prostrate, large- succulent-leaved herb. Corolla reduced, but 2-lipped, the upper shorter than the lower, the lips palish blue with yellow-green spot on lower side of mouth, stigma slowly irritable. AD97925247. **Isotypi:** 4 duplicates to be distributed.

Prostrate ?annual, moderately densely eglandular pubescent, with branches to c. 20 cm long. *Leaves* fleshy; petiole to 0.6 cm long; blade ovate to elliptic, to 2.5 cm long, obtuse. *Flowers* single, in most bract axils; pedicel 0-2 mm long. *Calyx* narrow cylindrical, 2-3 mm long, enlarging in fruit. *Corolla* obscure, c. 3-4 mm long, pale blue to ?white, with the lower side of the mouth yellow-green with no obvious palate; lips very short. *Stamens* 2. *Capsule* ovoid to ± globular, 3-4.5 mm long; seeds 0.7-1.4 mm long, furrowed.

P. foecundum is confined to the central arid regions of Australia, in all mainland states except Western Australia and Victoria. It grows in and beside ephemeral pools in clay to loam soils, often on gibber plains.

This species is notable amongst its congeners for its capacity to produce prolific fruits, from which is derived the specific epithet (from the Latin adjective *foecundus* meaning fruitful or bountiful). The fruits appear clustered in leaf axils, because of their being borne on axillary short shoots. It shares with *P. maritimum* a small corolla, but in *P. foecundum* the lips are not prone to spreading like all other species. This characteristic together with the abundant fruits and the low pollen-ovule ratio has led to the proposal that the flowers are at least facultatively autogamous (Barker 1982).

Selected specimens examined (73 total seen)

NORTHERN TERRITORY. BARKLY TABLELAND (1 seen): *W. Holtze 229*, 1895, Powell's Creek. MEL560956. CENTRAL AUSTRALIA NORTH (1 seen): *W.R. Barker 2825A*(p.p.), 19.viii.1978, Tanami Desert; c. 4.5 km by road WSW of Kims Bore on track to Ferdies Bore; c. 30 km WNW of Mongrel Downs Homestead. AD (2 sheets; 3 dupls.). CENTRAL AUSTRALIA SOUTH (7 seen): *A.C. Beauglehole 28003/5*, 29.vii.1978, Simpson Desert, 8.9 miles W of Old Andado Homestead, 3.1 miles E of New Andado Homestead. - *P.K. Latz 2601*, 24.v.1972, Tobermorey Station. AD (2 sheets) (ex NT). - *R. Swinbourne 804*, 24.xi.1964, 10 miles SW Alice Springs. AD, CANB, NSW, MEL, NT.

SOUTH AUSTRALIA. NORTH-WESTERN (1 seen): *R. Bates 19783*, 5.vi.1989, Marla. AD. LAKE EYRE (34 seen): *D.E. Symon 5703*, 17.viii.1968, 31 km S of the Cooper crossing at Innamincka (N end of Strzelecki Creek). AD (formerly ADW); n.v.: CANB, K, L. - *F.J. Badman 1127*, 1.vi.1984, McAlpine Bore, Anna Creek Station, 7 km W of William Creek. AD; (1 dupl.). - *R. Bates 19827*, 7.vii.1989, About Copper Hills. AD. - *T.R.N. Lothian 1374*, 7.viii.1963, 9 miles (c. 14 km) N of Warrina. AD; n.v.: NSW NT. - *W.R. Barker 3545* (see holotype). GAIRDNER-TORRENS (4 seen): *F.J. Badman 2842*, 24.vi.1989, 2 km N of Stuart Creek Opal Field, 42 km N of Andamooka. AD (2 sheets). EASTERN (4 seen): *J.Z. Weber 2207*, 6.viii.1971, 5 km W of vermin fence near Broughams' Cottage, which is on the E side of the S.A. - N.S.W. border and c. 155 km NNW of Broken Hill. AD; n.v.: CHR, NSW. MURRAY (1 specimen): *R. Bates 10147*, 14.viii.1987, 6 km N of Pine Valley Station. AD.

QUEENSLAND. GREGORY NORTH (2 seen): *P. Copley 819*, 24.vi.1981, Eastern Simpson Desert, between c. 45-75 km NW of Birdsville. AD. - *S.L. Everist 3979*, 11.vi.1949, Currawilla, about 100 miles W of Windorah; 5 Mile Paddock. BRI. GREGORY SOUTH (1 seen): *P.E. Conrick 2312*, 6.vi.1988, Barrioolah [Baryulah] Waterhole, Nappa Merrie Station. AD; n.v.: BRI. MARANOA (1 seen): *Helen I. Aston 2461*, 1.ix.1983, 20 km NE of St George along the road to Surat. 29 km S of Bindle. AD (ex MEL) BRI. MITCHELL: *D. Davidson 3506*, iii.1953, 16 miles NW of Longreach. BRIU3259. WARREGO (2 seen): *C.T. White 12080*, 29.iii.1941, Eulo. NSW.

NEW SOUTH WALES. NORTH FAR WESTERN PLAINS (9 seen): *C.W.E. Moore 8236*, 5.x.1981, "Mt Mulyah", about 60 km NW of Louth. CANB. - *J. Pickard 2381*, 26.vii.1973, 11 km SW "Yancannia". NSW. - *W.E. Mulham 1137*, 18 Aug 1977, "Burrawantie". NSW. SOUTH FAR WESTERN PLAINS (2 seen) W.E. Mulham W787, viii.1974, Kinchega National Park. NSW. REGION UNKNOWN (2 seen).

Glossostigma cleistanthum W.R. Barker, *sp. nov.*

G. spathulatum auct non Wight & Arn. ex Arn., partly: J. Black, *Fl. S. Austral.* (1926) 510.

G. submersum auct. non Petrie: ?Petrie, Trans. N. Zeal. Inst. 23 (1890) 401, partly (*Petrie WELT60049* appears to have been part of the type collection of *G. submersum* which otherwise comprises many sheets of *G. diandrum*).

G. sp.: W.R. Barker in Jessop, *Fl. Cent. Austral.* (1981) 332, fig. 431C.

G. sp. A: W.R. Barker, *Evolution Fl. Fauna Arid Austral.* (1982) 344, 346, 347; W.R. Barker in Jessop & Toelken, *Fl. S. Austral.* (1986) 1280, fig. 581D.

Species nova staminibus duobus *G. diandro* affinissima, non solum differt a speciebus omninibus differt floribus cleistogamis et fructibus subsessilibus, sed etiam a *G. elatinoides* lobis tribus calycis et a *G. trichodes* FvM. et *G. drummondii* Benth. staminibus duobus.

Holotypus: *W.R. Barker 3558*, 23.ix.1978. South Australia. Region 7: Eyre Peninsula. South extremity of main north-south ridge of Carappee Hill, ca. 7 km by road ENE of Darke Peak, ca. 100 m N of road. (33°26½'S 136°16'E). Prolific in occasional rockholes. In dark brown silt sometimes with *Limosella curdieana* (*Barker 3560*); within 20 m of pool with *Glossostigma* sp. (*Barker 3559*). On slopes of mountain with granite outcropping; ephemeral pools in depressions in granite. Creeping herb, submerged in ca. 10 cm water, but

in view of heavy rains over prior 2 days, possibly formerly exposed. Cleistogamous. Fruits hard, downturned in silt. Material fixed in ethanol. AD97930260. **Isotypi:** 5 duplicates to be distributed.

Small, glabrous, creeping, aquatic or terrestrial, cleistogamous, ephemeral or ?short-lived perennial herb, sometimes forming dense mats. *Leaves* in spaced pairs, 4-45 mm long, with the mid vein apparent throughout the lower side, sometimes obscure on drying, the thin flat, white to pale green petiole gradually dilated into a more or less thick, narrow obovate or oblong, obtuse, porrect, green or reddened blade (0.15-) 0.3-1 times longer and 1-3 times broader than the petiole. *Pedicels* usually 0-0.5 mm long, shorter than the leaves, downturned in fruit, rarely 5-9 mm long and erect. *Calyx* urceolate, green, enlarging to 1.5-3 mm long in fruit, never opening. *Corolla* rudimentary. *Stamens* 2, included. *Stigmatic lobe* narrow elliptic. *Seeds* 0.3-0.8 mm long.

G. cleistanthum is widely distributed though rare across central and south-eastern mainland Australia and in New Zealand. It grows in wet-montane to arid regions, in silt in rock pools, in clay on creekbeds, on swamp margins or river flats or in dams, and flowers and fruits whether exposed or submerged.

This species is distinguished from its congeners by its flowers which never open, its rudimentary corolla, and its usually sessile or subsessile flowers and fruits. The specific epithet derives from the first characteristic, coming from the Greek *cleistos,* meaning closed, and the Latinized adjectival form of the Greek *anthos,* flower. The proposal that the flowers are cleistogamous is supported not only by observation, but also by an extremely low pollen-ovule ratio (Barker 1982).

G. diandrum (L.)Kuntze is its closest ally, sharing with it the single pair of stamens. In rare instances *G. diandrum* also has cleistogamous flowers, but these tend to be stalked and occur on plants with normal flowers as well.

Selected specimens examined (58 total seen)

SOUTH AUSTRALIA. LAKE EYRE (2 seen): *Hj. Eichler 17236*, 3.ix.1963, Between Coober Pedy and Kulgera. C. 30 km N of the turnoff to Mabel Creek Homestead. AD. GAIRDNER-TORRENS (1 seen): *R. Bates 237*, viii.1978, Mt. Finke. AD. FLINDERS RANGES (4 seen): *E.C. Foster 191*, 12.ix.1987, Arkaroola Station, Mawson Plateau. AD. EASTERN (3 seen): *R.J. Chinnock 1268*, 29.ix.1973, Cathedral Rock near Plumbago. AD; (2 dupls.). EYRE PENINSULA (21 seen): *J.Z. Weber 3258*, 28.ix.1972, Childara Rockhole, 60 km W of Lake Everard Homestead. Gawler Range. AD, MEL; n.v.: CANB, CHR, NSW, BRI, TI. - *W.R. Barker 3591*, 25.ix.1978, Gawler Ranges; c. 4 km by road NNE of Hiltaba Homestead on road to Lake Everard Homestead; low hill c. 0.8 km E of road. AD; (1 dupl.). - *W.R. Barker 3608*, 26.ix.1978, Mt. Hall, c. 23 km NW of Port Kenny; upper slopes c. 100 m W of summit. AD; (3 dupls.). - *W.R. Barker 3647, 3649*, 28.ix.1978, Pine Hill, c. 200 m NW of Lincoln Highway, c. 58 1/2 km direct WSW of Whyalla. AD; (1 dupl.). NORTHERN LOFTY (1 seen): *R. Bates 18631B*, 4.vi.1989, Along railway N of Terowie. AD. MURRAY (7 seen): *W.R. Barker 4597*, 24.iv.1983, Walker Flat, 150 m N of common ground on E side of ferry crossing, Murray River. AD; (1 dupl.). - *W.R. Barker 3793 & R.M. Barker*, 11.ix.1979, River Murray, S bank opposite Isle of Man (Newena Island), ca. 1.25 km NW of Nelwood Homestead. AD; (1 dupl.).

NEW SOUTH WALES. SOUTHERN TABLELANDS (2 seen): *J. Thompson 1947*, 28.i.1974, Diggers Creek Reservoir, Kosciusko National Park. NSW. SOUTH WESTERN PLAINS (3 seen): *E.J. McBarron 4708*, 14.vii.1950, Bulgandry Reserve, Bulgandry. NSW.

VICTORIA. NORTHERN PLAINS (6 seen): *H.I. Aston 523*, 8.ii.1960, Kow Swamp, W of Gunbower. MEL. EASTERN HIGHLANDS (1 seen): *A.C. Beauglehole 36614 & E.W. Finck*, 29.i.1971, East Gippsland; Native Cat Plain, MEL.

NEW ZEALAND. NORTH ISLAND. SOUTH AUCKLAND (1 seen): *P. Lynch s.n.*, iii.1972, Lake Rotoehu, CHR243916. SOUTH ISLAND. CANTERBURY (1 seen): *R. Mason 9367*, 27.iii.1962, Lake Heron, Ashburton County, CHR. OTAGO (2 seen): *D. Petrie s.n.*, s.dat., Waihola Lake, WELT60049. SOUTHLAND (1 seen): *R. Mason 12794 & E.M. Chapman*, 25.ii.1973, 8 m[iles] NW of Riversdale, by Mataura River, CHR.

CULTIVATED or ADVENTIVE (2 seen). *H.C. Jones s.n.*, 24.xi.1978, From aquarium tanks W.R.C. [?Water Resources Commission] Griffith, probably originally from Grafton area [The reference to Grafton is probably erroneous considering the limit of distribution of the species is far to the south in A.C.T.-Griffith area]. NSW144630. - *A.H.S. Lucas s.n.*, ii.1916, Bot[anic] Gardens, Sydney. SYD, NSW144625.

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NEW TAXA AND COMBINATIONS IN THE MYOPORACEAE

R.J. Chinnock

State Herbarium, Botanic Gardens, North Terrace, Adelaide, 5000.

Abstract

Two new subspecies in *Myoporum*, *M. boninense* subsp. *australe* and *M. platycarpum* subsp. *perbellum* and two new subspecies in *Eremophila*, *Eremophila bowmanii* subsp. *nutans* and *E. divaricata* subsp. *callewatta* are described. The following new combinations are made: *Eremophila debilis*, *Eremophila bowmanii* subsp. *latifolia*, *Eremophila oppositifolia* subsp. *rubra* and *Eremophila latrobei* subsp. *glabra*.

In preparation for the Myoporaceae treatment in volume 3 of the Flora of New South Wales expected to appear soon the following new subspecies are described and new combinations made.

1. **Myoporum boninense** subsp. **australe** Chinnock, *subsp. nov.* Fig. 1.A

Pogonia glabra Andr., Bot. Repos. 4: t. 283 (1803).

Type: Bot. Repos. 4: t. 283.

Myoporum ellipticum R. Br., Prod. 515 (1810), *nom. illeg.*

Type: R. Brown s.n. [Bennett No. 2802], Port Jackson, no date (BM, K).

Myoporum acuminatum var. *ellipticum* (R. Br.)Benth. based on *Myoporum ellipticum*.

Myoporum insulare sensu Beadle, Carolin & Evans, Fl. Syd. Region edn 3: 507 (1982).

a subsp. *boninensi* corolla intra hirsuta, floribus (1-) 2-5 (-8) in axillis differt.

Type: north side of Batemans Bay, New South Wales, *R.J. Chinnock 6654*, 8.ii.1986 (holotype: AD; isotypes: BRI, NSW, TI).

Notes

The cultivated plant upon which Andrews based *Pogonia glabra* originated from New Holland and was first raised from seed in England by a Mr Robertson in 1790. The plant depicted in Andrew's plate was drawn at the Hammersmith Nursery and as far as I can determine no pressed specimen was preserved.

Mueller (Myo. Pl. Austr. (1886) plate 70) indirectly published the name *Myoporum glabrum* through a descriptive illustration and gave no indication that the name was based on Andrews *Pogonia glabra*. The illustration, however, clearly depicts a form of *Myoporum montanum* R. Br.

Robert Brown based his *Myoporum ellipticum* on Andrews *Pogonia glabra* but unfortunately his name is illegitimate being superfluous at time of publication.

Fig. 1. *Myoporum boninense* subsp. *australe* (cult. Adelaide Botanic Garden). A, habit of prostrate branches; *Myoporum platycarpum* subsp. *platycarpum* (*A.C. Robinson 750*). B, pendulous branch showing the prominent flexuous arrangement of the flowering shoots and small flowers; *Myoporum platycarpum* subsp. *perbellum* (*E.C. Black s.n.*, AD 97620122). C, habit showing the non-flexuose branch and large flowers (cf. B); *Eremophila bowmanii* subsp. *nutans* (*R.J. Chinnock 6218*). D, habit of branch; *Eremophila divaricata* subsp. *callewatta* (based on type). E, habit of branch with fruit enlarged. Illustration by G.R.M. Dashorst.

Koidzumi (Bot. Mag. Tokyo (1918) 32: 53) published *M. boninense* basing it on collections made by S. Nishimura on Chichisima Island in the Bonin group south-east of Japan. A study of material from this island group as well as the Marianas Islands further to the south (eg. Pagan, Roto, Guam) confirm that this species is also the widely spread one found along the eastern coast of Australia previously referred to as either *M. ellipticum* or *M. insulare*. This latter species replaces *M. boninense* in the extreme south of New South Wales and extends through coastal Victoria and South Australia to coastal Western Australia as far north as Shark Bay.

M. boninense is here divided into two subspecies on the basis of floral indumentum and the number of flowers per axil.

Myoporum boninense is the most widely spread species of *Myoporum* and its distribution over such a long distance between the Bonin Islands (28°N) and Australia (13°S northernmost Australia occurrance) may possibly be accounted for through bird dispersal. According to Mr S. Parker, S.A. Museum, the short tailed - shearwater migrates between Australia and these island areas to the north.

The subspecific epithet alludes to this subspecies being the southern form of the species.

2. **Myoporum platycarpum** subsp. **perbellum** Chinnock, *subsp. nov.* Fig. 1.C

a subsp. *platycarpo* corollarum lobis tubum aequantibus vel longioribus; arboribus ramis floralibus non valde flexuosus; folio pedicellique vestigio non formanti nodosis prominentibus differt.

Type: 10 km E of Sedan, South Australia, *R.J. Chinnock 2974*, 9.xi.1975 (holotype: AD; isotypes: K, KSC, MEL, NSW).

Notes

This subspecies is readily distinguished by its larger more prominent flowers 8-16 mm diameter and the floral branches not obviously flexuous. Leaf and pedicel remnants do not form prominent knobs found in the type subspecies (Fig. 1.B) except very rarely in some New South Wales populations.

It extends from south eastern South Australia to north-western Victoria and also occurs in central southern New South Wales. It is usually associated with mallee woodlands forming a tall multistemmed shrub or rarely a small tree. *M. platycarpum* subsp. *platycarpum* however, is most commonly associated with *Acacia* woodlands especially *A. aneura* and *A. papyrocarpa* or it forms open woodlands over chenopod shrublands.

The subspecific epithet refers to the larger more attractive flowers found in this subspecies.

3. **Eremophila debilis** (Andr.)Chinnock, *comb. nov.*

Pogonia debilis Andr., Bot. Repos. 3: t. 212 (1802).

Type: Bot. Repos. 3: t. 212.

Andreusia debilis (Andr.)Vent., Jard. Malm. tab. 108 (1803).

Myoporum debile (Andr.)R. Br., Prod. 516 (1810).

Notes

Features of the flower and fruit clearly place this species in *Eremophila.* The corolla has a long narrow cylindrical lower portion and irregularly arranged lobes with the medial one of the lower lip usually projected forward. Unlike *Myoporum* the sepals are larger, lanceolate to oblanceolate and have an outer three inner pair arrangement. The large fruit is fleshy but not watery like *Myoporum* and the endocarp is distinctly compressed with the two carpels free in the upper fifth. This latter feature occurs in a number of sections of *Eremophila.*

4a. **Eremophila bowmanii** subsp. **nutans** Chinnock, subsp. nov. Fig. 1.D

a subsp. *bowmanio* foliis ovatis ad suborbiculatis raro oblanceolatis, foliis pedicellisque grosse dendritico-tomentosis, floribus nutantibus differt.

Type: 9.5 km S of junction with the Quilpie - Windorah road, on Thargomindah road, Queensland, *R.J. Chinnock 6219*, 23.ix.1984 (holotype: AD; isotypes: BRI, CANB, K, MEL, MO, NSW).

Notes

This is a much smaller plant than the other two subspecies favouring stony red-brown clay flats or rocky rises usually as small populations in low *Acacia* woodlands (*A. cambagei, A. aneura*) often with other species of *Eremophila* and *Senna*. It is restricted to the Warrego District in Queensland and extends just over the border to near Yantabulla in New South Wales.

The subspecific epithet refers to the flowers which become nodding as the fruit develop.

4b. **Eremophila bowmanii** subsp. **latifolia** (L.S. Smith)Chinnock, stat. nov.

Eremophila bowmanii var. *latifolia* L.S. Smith, Contr. Qld Herb. 19: 24 (1975).

Type: Bulloo River, New South Wales, *L. Morton s.n.*, 1887 (holotype: MEL).

5. **Eremophila divaricata** subsp. **callewatta** Chinnock, subsp. nov. Fig. 1.E

a subsp. *divaricata* ramis foliis fructisque stellato-pubescentibus differt.

Type: North Bourke between the Darling River and Polygonum Swamp, New South Wales, *R.J. Chinnock 6325*, 27.ix.1984 (holotype: AD; isotypes: AD, BRI, K, MEL, NSW, PERTH, US).

Notes

This subspecies is known only from the vicinity of Bourke where it grows on the floodplains of the Darling River. It is easily distinguished from subsp. *divaricata* by the stellate tomentum covering the branches, leaves and fruits. In the type subspecies stellate hairs are restricted to just above the leaf axil and never present on the leaves or fruit.

The subspecific epithet is taken from an Aboriginal name for the Darling River.

6. **Eremophila oppositifolia** subsp. **rubra** (C. White & Francis)Chinnock, stat. nov.

Eremophila oppositifolia var. rubra C. White & Francis, Proc. Roy. Soc. Qld 37: 162 (1926).

Type: Near Wilson River, south-western Queensland, *W. MacGillivray s.n.*, 4.ix.1923 (holotype: BRI 192741; isotype: K).

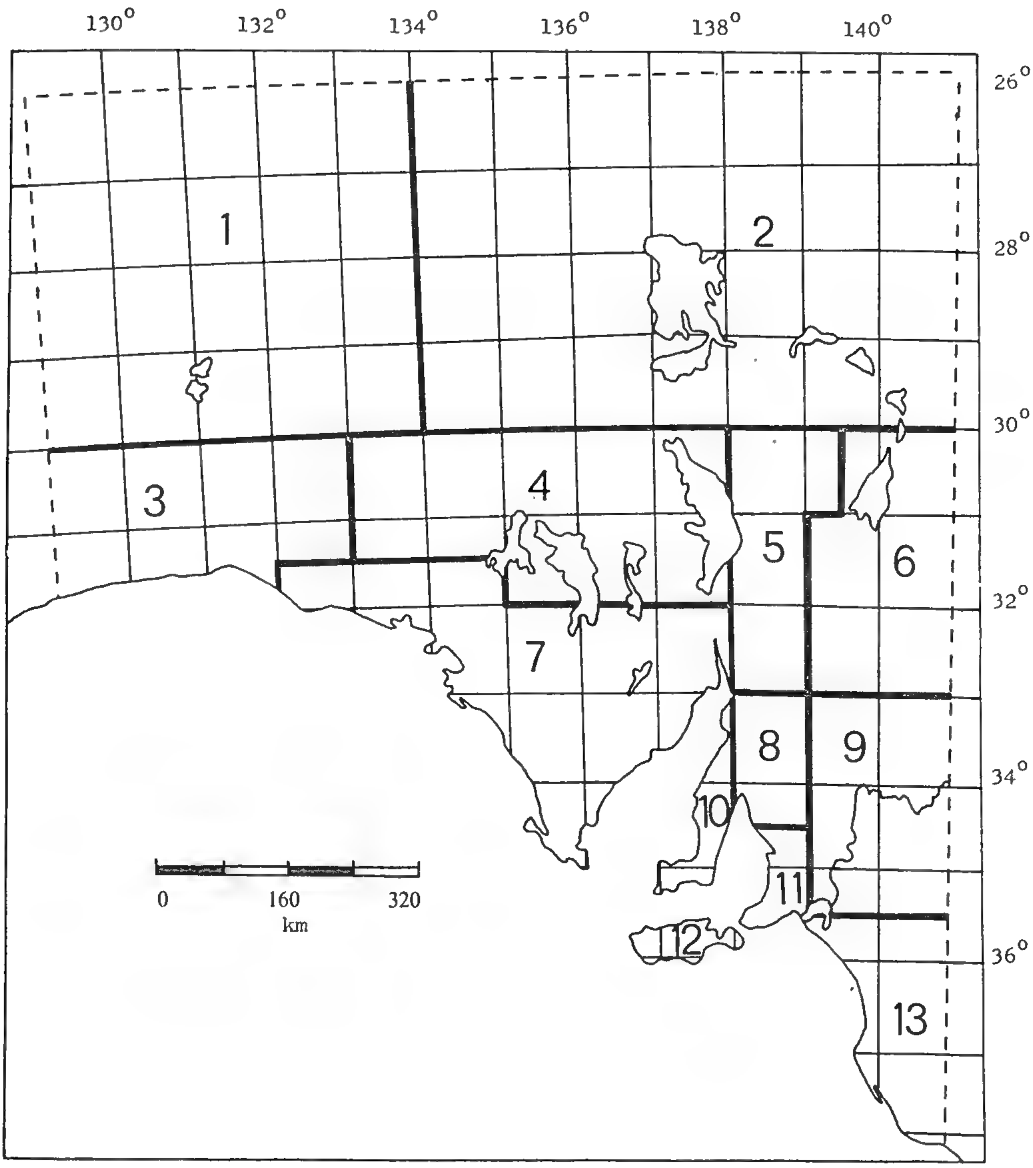
7. **Eremophila latrobei** subsp. **glabra** (L.S. Smith)Chinnock, stat. nov.

Eremophila latrobei var. *glabra* L.S. Smith, Contr. Qld Herb. 19: 21 (1975).

Type: Tenham near Windorah, Queensland, *S.T. Blake 12030*, vi.1936 (holotype: BRI).

REGIONS OF SOUTH AUSTRALIA ADOPTED BY THE STATE HERBARIUM — ADELAIDE

1. North-western
2. Lake Eyre
3. Nullarbor
4. Gairdner-Torrens
5. Flinders Ranges
6. Eastern
7. Eyre Peninsula
8. Northern Lofty
9. Murray
10. Yorke Peninsula
11. Southern Lofty
12. Kangaroo Island
13. South-eastern



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HANSJOERG EICHLER*

1 April 1916 — 22 June 1992

Born on 1 April 1916 in Ravensburg in south west Germany, Hansjoerg Eichler grew up amongst forests, rural fields, meadows and streams: so began his life-long interest in hydrophytes. His boyhood ambition to become a botanist was kindled early by an enthusiastic school teacher who stimulated his curiosity in the local flora.

After his family moved to Berlin Professor Ludwig Diels became Eichler's inspiration and mentor allowing the young student working space in the Botanische Museum Berlin-Dahlem, and encouraging him to pursue a scientific career.

The war in Europe (1939 - 1945) profoundly affected him and the scars remained throughout his life. Military training and later war service with the German Air Force (signal corps) interrupted his studies. But more personally devastating were the effects of the March 1943 bombing raids on Berlin which destroyed his home, his growing personal herbarium and botanical library and also burnt down the Botanische Museum.

As one of a group of promising young German scientists in February 1944 Eichler was exempted from war service to study and work at the Kaiser-Wilhelm-Institut. Situated at first on the outskirts of Vienna, war activities forced the Institut to relocate to central Germany near the Harz Mountains. It was thus that Eichler found himself post-war in 1953 in Gatersleben, East Germany under Russian authority when the East German Academy of Science re-established the research institution.

He gained his *Dr. rer. nat.* at the University of Halle-Wittenberg with his dissertation "Floristische und phytozönologische Untersuchung des Hakels und seiner nächsten Umgebung" in 1950.

Despite numerous upheavals and traumas during his years at the Kaiser-Wilhelm-Institut his experience gained in assisting with building-up the herbarium, collaborating with taxonomic revisions and experimenting with living plants gave him an excellent grounding in his chosen profession. A post-doctoral scholarship from the West German Forschungs-Gemeinschaft enabled him to enjoy eighteen months of uninterrupted research based at the Rijksherbarium, Leiden — a period of his life which he found professionally most rewarding. While there he worked on a revision of Ranunculaceae for the Flora Malesiana. A fortuitous brief working visit to check bibliographic notes at Kew Herbarium brought him in contact with British colleagues who told him of a post advertised in Australia.

Before long he was on his way to take up his appointment as the first Keeper of the State Herbarium at the Adelaide Botanic Garden, South Australia. He held this position until 1973. Hansjoerg Eichler and his wife Marlies arrive by ship in Adelaide on 6 November 1955 with high hopes and ready for new challenges; he began work on 8 November.

The Adelaide Botanic Garden sixth Director T.R.N. (Noel) Lothian had, from the time of his appointment in 1947, battled government departments' apathy and red tape to achieve the re-

* Eichler's extensive botanical library has been donated to the National Herbarium (formerly Herbarium Australiense), Canberra.
A complete bibliography of his publications will be published in Taxon (West & Hewson, in press).
His herbarium collections, last number 24236, are deposited mainly in the State Herbarium, Adelaide (AD) and the National Herbarium, Canberra (CANB).

establishment of a herbarium at the Garden. This would be a State Herbarium to bring together many of the scattered collections held both privately and in institutions around the State.

It was unfortunate that from the outset strong personality and character clashes prevented Eichler and Lothian working amicably together towards what was, in fact, a common goal — a world class herbarium. E. Stirling (Ted) Booth, who had been Acting Herbarium Keeper for some months previously, warmly welcomed the Eichlers and they remained life-long friends. He was an admirable cultural bridge both in the social and scientific spheres while Eichler became acquainted with his adopted country and settled into his new job.

At the time of his arrival the infant herbarium occupied two rooms (without doors) in the Botanic Garden administrative building. Equipment was minimal and funds scarce. The nucleus of the herbarium — the Richard Schomburgk collection and the University of Adelaide material on permanent loan, principally the Ralph Tate and John McConnell Black collections, all in dire need of curation — had already been delivered. There was no space for any of the other promised material.

Eichler was a rigorous professional well-grounded in classical taxonomy and traditional herbarium procedures. He could see clearly what needed doing and how it should be done. A short paper entitled "The collection of plants and its importance for systematic botany" was prepared (Booth & Eichler, 1956) within weeks of his arrival to stimulate interested people to collect plants scientifically.

The amount of technical work (sorting, labelling, mounting, rearranging) to be done before the existing collections could be made available for use in scientific research was overwhelming. Very early he set up a model of how he believed a family should be curated using Pittosporaceae as an example. He longed to get on with his own research "to revise the genus *Clematis* in Australasia ... to investigate the relations between the Australasian *Ranunculus* species and those of New Guinea ... and to revise the phanerogamic hydrophytes" (Herbarium Annual Report 1955/56).

Equipment was gradually purchased as funding became available — labels, folders, boxes, presses, straps, a microscope, a microtome, a drying cupboard — and power points and a telephone were installed. Gradually more staff were employed. Eichler's frustrations were obvious in his reports as he worked steadily, methodically towards achieving his goal — a herbarium of international standards known and respected in international scientific circles.

> "... it should not be forgotten the cultural level of a State is judged by the level of its cultural institutions; one of them is a herbarium" (Herbarium Report June 1957).

There was pride within the Botanic Gardens Board in achieving a herbarium but for most members no appreciation of the tremendous task involved in curation. Insistence that the Herbarium be open to the public and that an identification service be given highest priority depressed and exasperated, but did not discourage Eichler. He refused to compromise his procedural standards and maintained that taxonomic research should come before a local public image. He was appalled at the rapid destruction of indigenous vegetation in Australia, and South Australia in particular, as land was put "under the plough". He was a staunch advocate of conserving natural bushland in large reserves.

There was always a sense of urgency — collecting good topotypes before all native vegetation disappeared from the State's agricultural regions. Field trips were carefully planned to visit type localities of taxa described by earlier botanists, particularly Black, Tate and Robert Brown. He stressed the importance of adequate duplicates when collecting to foster exchange between other herbaria both interstate and overseas.

Hansjoerg Eichler (December 1967) Photo: W.M. Hodge

Eichler had the ability to inspire amateurs — field naturalists and others — to collect for him, a trait reminiscent of Ferdinand Mueller a century earlier. As with his staff he expected, and demanded high standards, and many later told with amusement of their enforced apprenticeships before being accepted as legitimate collectors.

From the beginning University of Adelaide undergraduate botany students were willing volunteers during vacation times mounting and labelling specimens at the Herbarium. Some were stimulated to continue to higher degrees doing taxonomic revisions under Eichler's supervision and enthusiastically acknowledged the benefits they gained from his tenacious insistence on high standards. The University of Adelaide bestowed on him an honorary Ph.D (1959) and an honorary lectureship in Botany (1965-1975).

He brought to Australia his small botanical library which he made available to all staff and visitors at the Herbarium. He worked hard to build up taxonomic literature in the Botanic Garden library, including journals not available elsewhere in South Australia. He promoted the idea of buying microfiche editions of rare botanical works.

Eichler felt keenly his isolation from other taxonomists. He welcomed opportunities such as annual ANZAAS meetings to join interstate colleagues in discussions. During his fifteen month secondment to Kew (1961-62) as Australian Botanical Liaison Officer he enjoyed his respite from administrative duties. He examined taxonomic problems involving European plants naturalised in Australia, studied types of Australian species housed in European herbaria and consulted directly with colleagues. Four papers published in *Taxon* in 1963 resulted. In addition a task begun immediately on his arrival in Adelaide was considerably advanced viz. the nomenclatural revision of Black's Flora of South Australia. This was finally published in June 1965 as a massive 385 page "Supplement to J.M. Black's Flora of South Australia (2nd edn 1943-57)".

The Herbarium had expanded rapidly over the years to fill far more than the two rooms Eichler had found on his arrival in Adelaide. Work began in 1964 on a much needed two storied building designed specifically as a modern herbarium. Internally many features bore testimony to his rigorous attention to detail. This new State Herbarium, occupied in October 1965 by Eichler and his staff, was recognised at that time as the best-equipped in Australia possessing amongst other things the best in modern storage, a motorised compactus system.

In 1973 Eichler left Adelaide to take up his appointment as Curator at Herbarium Australiense, CSIRO Division of Plant Industry, Canberra, ACT. He left behind a growing Herbarium of international standing with an able research staff and technicians well-grounded in sound curatorial practices and techniques.

His period (1973-81) at Herbarium Australiense was very different from that in Adelaide. He took over a well-developed herbarium which was about to move into its new building. His role was mainly administrative. He was able to entice overseas taxonomists to join his staff. He negotiated the return to Australia of duplicates of many Robert Brown collections from the 1802-05 "Investigator" voyage — material of inestimable value to Australian taxonomists. Another significant achievement was the launching of *Brunonia*, a taxonomic journal of international standing to replace the earlier *Contributions from Herbarium Australiense.*

From the time of the Adelaide ANZAAS meeting in August 1958 when Professor J.G. (Joe) Wood got the proposal to produce a Flora of Australia off the ground, Eichler was an enthusiastic supporter. He saw this as an enormous step forward which would be a huge stimulus to taxonomic research in Australia. He certainly had an influence in shaping the project and, as always, championed high scholarly standards. He served on all the various Flora

committees from the first New Flora of Australia Committee (1958-59) through to the first Editorial Committee (1981-82).

Following his retirement from Herbarium Australiense Eichler concentrated on his own research — the revisions of Zygophyllaceae, Umbelliferae and Ranunculaceae for the Flora of Australia. He completed the manuscript for Ranunculaceae early in 1992 and the other treatments were well advanced.

In recognition of his substantial contribution to professional taxonomy and to our knowledge of the Australian flora eight species, by various authors have all been named in his honour.

Eichler was a professional nomenclaturist, through and through: for him applying the International Code was automatic and became almost an obsession. He was an active member of the International Commission on Botanical Nomenclature of the International Union of Biological Sciences (Committee for Spermatophyta) from 1968 until 1992. At the time of his death he was preparing a proposal to take to the XV International Botanical Congress in Tokyo in 1993.

He died of a heart attack in Germany where he and Marlies were visiting relatives and furthering his research. It seems appropriate that his last days were spent at Berlin-Dahlem Herbarium, which he had held in deep affection since his first youthful contact in 1936. It was with pride that he had, in 1979, accepted the Willdenow Medal, a recognition of his personal contribution to that herbarium presented on the occasion of the 300th anniversary celebrations of the Botanic Garden, Berlin.

From the time of their marriage in 1953 Hansjoerg was actively supported and strongly encouraged in all his endeavours by his wife Marie-Luise (Marlies), née Möhring, who survives him. Indeed, without children, they both devoted their lives to promoting taxonomic botany in Australia.

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Enid L. Robertson
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TAGASASTE IN THE CANARY ISLANDS IN THE 17TH CENTURY

J. Francisco-Ortega*, H.J. Newbury & B.V. Ford-Lloyd

School of Biological Sciences, The University of Birmingham, P.O. Box 363, B15 2TT, Birmingham, United Kingdom

O. Soriano

Museo de Ciencias Naturales, Calle José Gutiérrez Abascal Num. 2, E-28006, Madrid, Spain

Abstract

A reference found in Archivo Histórico Nacional (Madrid) to a place called "Hoya del Tagasaste" ("Tagasaste Pit") on the island of El Hierro for the year 1659, could represent the oldest known quotation on typical tagasaste (*Chamaecytisus proliferus* (L. fil.) Link ssp. *proliferus* var. *palmensis* (Christ) Hansen & Sunding) in the Canary Islands. Ecogeographical studies have suggested that tagasaste is endemic to the island of La Palma. Therefore this finding indicates that either tagasaste was introduced from La Palma as a cultivated species earlier than it was previously believed or that it refers to another endemic *Chamaecytisus* of El Hierro (escobon of El Hierro = *C. proliferus* ssp. *proliferus* var. *hierrensis* (Pitard) J.R. Acebes) which is now known as "tagasaste salvaje" (wild tagasaste) or "tagasaste de risco" (cliff tagasaste) by peasant farmers of this island.

Introduction

Tagasaste (*Chamaecytisus proliferus* (L. fil.) Link ssp. *proliferus* var. *palmensis* (Christ) Hansen & Sunding) is a fodder shrub which is endemic to the island of La Palma in the Canary Islands. Together with six other morphological types, it forms a species complex endemic to the Canary Islands (Table 1).

The word "tagasaste" is regarded as having a Berber derivation (Wolfel, 1965, p. 445), and Foucauld (1940, p. 85; 1951, p. 489) reported the use by the native people of northern Africa of the Berber word "tagsest" for either a grass with thick leaves or for any perennial species. In the late 16th Century, Frutuoso (1590, p. 121) reported the occurrence in La Palma of a bush known as "tagetes" which could have referred to the actual tagasaste endemic to this island.

The younger Linnaeus (1781, p. 328) gave the first botanical description of *C. proliferus* as *Cytisus proliferus*, and this was based on material gathered in Tenerife by the British plant collector F. Masson (Linnaeus fil., 1781, pp. 27, 328). The work of the younger Linnaeus in 1781 produced the first type description for the *C. proliferus* complex. However, in 1694 and 1696 the British herbalist Leonard Plukenet reported as *Cytisus arboreus Canariensis*, what appear to have been plants of white escobon of Tenerife (Plukenet, 1694, tab. 277; 1696, p. 128). This English botanist reported it as a *Cytisus*, not previously described, from the Canary Islands, which had white flowers and sericeous leaves and which was known as "texo" by the natives of the archipelago (Fig. 1A). A voucher from Plukenet's herbarium (Fig. 1B) at the British Natural History Museum (BM) (Sloane Herbarium Vol. 96) is of white escobon of Tenerife and is very similar to the plant illustrated in his work from 1694. Although the specimen illustrated in Figure 1A is not from a plant of typical tagasaste, it represents the oldest known dried specimen of a morphological form of the *C. proliferus* complex.

*Department of Agriculture, University of Reading, PO Box 236, Reading RG6 2AT, United Kingdom

Figure 1: Plukenet's illustration (pointed in A) of 1696 is believed to be the oldest published reference concerning *Chamaecytisus proliferus* from the Canary Islands. It refers to a plant of white escobon of Tenerife (pointed in B) found in Plukenet's herbarium (BM, Sloane Herbarium Vol. 96, page 2). Courtesy of Department of Botany, British Museum (Natural History).

The first reports on the cultivation and use of typical tagasaste in La Palma were given by Pérez (1862) who has also been considered as the first person to propagate tagasaste from this island (Pérez-Ventoso, 1892). Furthermore, Francisco-Ortega et al. (1991) suggested that it was likely that the oldest reference on tagasaste came from an undated herbarium specimen held in the Herbarium Webbianum in Florence (FI). The label of this specimen states that plants of *C. proliferus* from La Palma were known as tagasaste. Moreover the handwriting on this label appears to be that of the botanist P.B. Webb (C. Nepi pers. comm.) which means that it could have been mounted between Webb's stay in the Canary Islands in 1828 and his death in 1854 (Stearn, 1937).

Díaz-Padilla & Rodríguez-Yanes (1990, p. 217), in their work concerning the history of the islands of La Gomera and El Hierro from the conquest until the 18th century, claimed that in the Archivo Histórico Nacional (AHN) in Madrid, there was a reference dated 1659 to a location on the island of El Hierro named "Hoya del Tagasaste" ("Tagasaste Pit" = "Tagasaste Depression"). They mentioned that the reference was found in the book 2557, sheets 455 and 516 of the "sección del clero" (clergy section) of the AHN.

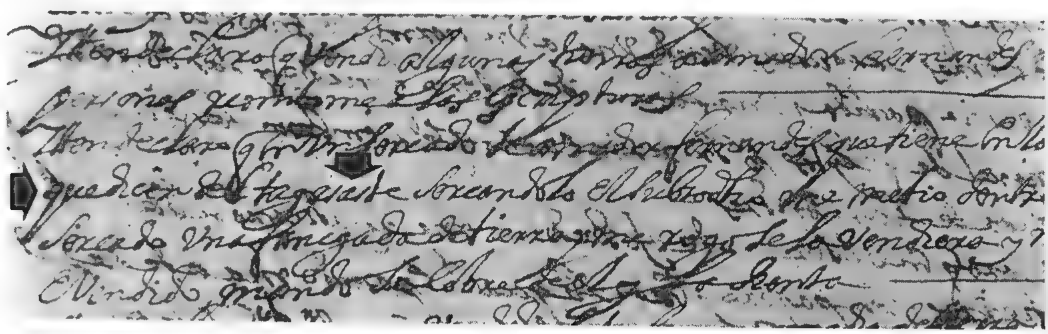

Figure 2: Page of the will of Hernando Díaz de Aguiar (AHN, Book 2557, reverse side of sheet 458, Sección del Clero) from 1659 where the oldest known reference to tagasaste (pointed) in the Canary Islands is found. Courtesy of Archivo Histórico Nacional, Madrid, Spain.

As the work of Díaz-Padilla & Rodríguez-Yanes (1990) was concerned mainly with the history of these two islands they did not discuss the possible relevance of this finding to the history of tagasaste as a cultivated species. We therefore aim to confirm that this is the oldest known reference on tagasaste, and to provide a brief discussion on the possible occurrence of this fodder legume in the island of El Hierro.

Details of the earliest description

The earliest known evidence for the use of the word tagasaste is found in documents held at AHN, and refers to a locality of the island of El Hierro. An extract of this document is illustrated in Figure 2 which clearly indicates that a place from this island received the name of "Hoya del Tagasaste" ("Tagasaste Pit") in 1659. It is found on the reverse side of sheet 458, in book 2557 of the clergy section, and it is part of the will of Hernando Díaz Aguiar. The locality "Hoya del Tagasaste" is mentioned twice on this page. Line 14 from this page states that this part of the will refers to the island of El Hierro. The whole document was written on March 20th, 1659 and is six pages long, from sheet 455 to sheet 460. On lines 21 and 22 of the reverse side of page 458 it is stated "... declaro que en un cercado de Amador Fernández que tiene en la hoya que dicen del tagasaste..." (... I declare that in a place of Amador Fernández which is located in the pit which is known as tagasaste...), furthermore on line 31 from the same page, is stated "...por haber puesto los linderos en la hoya del tagasaste..." (...because the boundaries

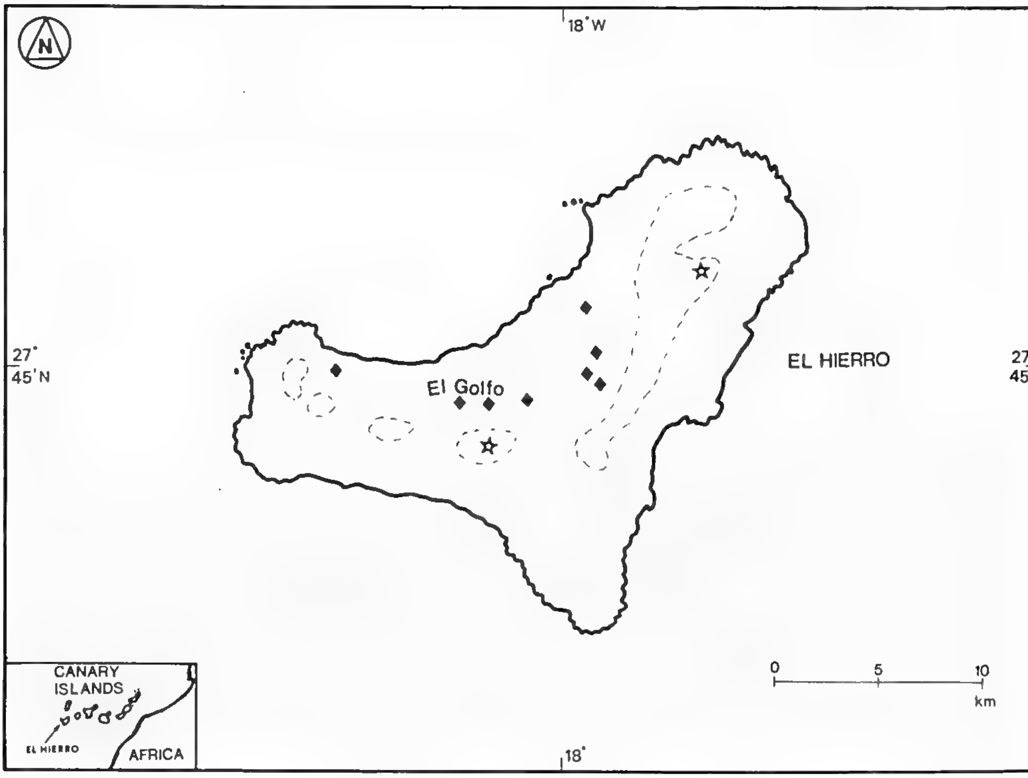

Figure 3: Map of the island of El Hierro showing the distribution of cultivated tagasaste inside the marked areas (--); localities where *C. proliferus* var. *hierrensis* is reported (♦); and location of the two places which nowadays receive the name of "Hoya del Tagasaste" (☆). Adapted from Pérez de Paz et al. (1986) and Francisco-Ortega (1992).

were establised in tagasaste pit..). It is also stated (line 27) that this locality was close to a place known as "Los Cercaditos de Marco Antonio". The fact that this reference is recorded in a will, which can be regarded as an official document, suggests a degree of authenticity. Although Díaz-Padilla & Rodríguez-Yanes (1990) indicated that references to "Hoya del Tagasaste" could be found on sheets 455 and 516, it is not recorded on these two pages. Furthermore sheet 516 is part of another will of Leonor Peraza. Although we have not found any locality with the names of "Hoya del Tagasaste" or "Los Cercaditos de Marco Antonio" on any known maps of El Hierro, J.R. Acebes-Ginovés (pers. comm.) has stated that there are at least two places in the island known as "Hoya del Tagasaste" (Fig. 3). One is found in El Julan, in the south, and the other on the eastern plateau of San Andrés. Both localities are outside the recognised distribution range of escobon of El Hierro (*C. proliferus* ssp. *proliferus* var. *hierrensis*) but they are within the present zone of cultivated tagasaste (Fig. 3).

Despite the fact that the word tagasaste is commonly used in the archipelago for *C. proliferus* var. *palmensis*, peasant farmers from El Hierro also know escobon of El Hierro as "tagasaste salvaje" (wild tagasaste) or "tagasaste de risco" (cliff tagasaste) (Table 1 gives a summary of common names of *C. proliferus* from the Canary Islands) which means that the locality "Hoya del Tagasaste" could be related to *C. proliferus* var. *hierrensis*, and that it might have been found in an area closer to El Golfo cliffs where this species exists today (Fig. 3). This morphological form only occurs in this region and it is not cultivated.

Morphological form	Spanish common name	Geographical region
C. proliferus ssp. *proliferus* (White escobon of Tenerife)	Escobón blanco Escobón Escobón de monte	Northern Tenerife Northern Tenerife Northern Tenerife
C. proliferus ssp. *proliferus* var. *canariae* (White escobon of Gran Canaria)	Escobón blanco	Northern Gran Canaria
C. proliferus ssp. *proliferus* var. *palmensis* (Typical tagasaste)	Tagasaste Tagasaste negro Tasagaste Satagasate Escobón negro Tagasaste palmero	La Palma, Tenerife, Gran Canaria, El Hierro and La Gomera Caldera de Taburiente (La Palma) La Palma and Gran Canaria La Palma and Gran Canaria Gran Canaria La Gomera
C. proliferus ssp. *proliferus* var. *calderae* (White tagasaste)	Tagasaste blanco Tagasaste azul	Caldera de Taburiemte (La Palma) Northern La Palma
C. proliferus ssp. *proliferus* var. *hierrensis* (Escobon of El Hierro)	Tagasaste salvaje Tagasaste de risco Escobón	El Hierro El Hierro El Hierro
C. proliferus ssp. *angustifolius* (Narrow-leaved escobon)	Escobón Tagasaste criollo Tagasaste	Tenerife La Gomera La Gomera
C. proliferus ssp. *meridionalis* (Escobon of southern Gran Canaria	Escobón	Southern Gran Canaria

Table 1: Spanish common local names for the seven forms of *C. proliferus* in the Canary Islands after Santos-Guerra (1983). Pérez de Paz et al. (1986), Acebes-Ginovés (1990) and Francisco-Ortega (1992). Farmers from La Palma know as "tagasaste mollar" a form of white tagasaste or typical tagasaste which is easier to prune. Farmers from northern Gran Canaria call "escobón mulato" plants that seem to be hybrids between typical tagasaste and white escobon of Gran Canaria. Forms of typical tagasaste with larger leaves are known as "tagasaste hembra" or "tagasasta" whilst forms with small leaves are known as "tagasaste macho" in La Palma. *Ephedra fragilis* (Ephedraceae), in La Palma, and *Spartocytisus filipes* (Fabaceae), in La Palma and La Gomera, are also called escobón. Note that the word tagasaste is not used in the archipelago to name any other species from the Canary Islands.

If this locality really refers to an area where typical tagasaste used to be cultivated, it would mean firstly that it was introduced from La Palma earlier than it was previously believed and that Dr Victor Pérez was not the first person to propagate tagasaste from this island (Francisco-Ortega et al., 1991), and secondly that the species has been under cultivation from the 17th century despite the fact that none of the botanists from the 16th-18th century reported tagasaste as a cultivated species in the Canary Islands (Francisco-Ortega et al., 1991).

Whether this locality represents the occurrence of *C. proliferus* var. *palmensis* or *C. proliferus* var. *hierrensis* cannot be ascertained at present. However, we are convinced that the word tagasaste found in this document from AHN refers to one of the morphological forms of *C. proliferus*; this word *has never* been used either by any botanist or by local people to refer to another species from the Canary Island flora. It is likely that further research in this or other archives will provide more information concerning the cultivation and use of this fodder species by peasant farmers in the Canary Islands before 1862. For now this should be considered as the earliest reference on the occurrence of this endemic species in the Canary Islands.

Acknowledgements

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NEW TAXA AND COMBINATIONS IN THE BORAGINACEAE

B.R.Randell

State Herbarium, Botanic Gardens, North Terrace,
Adelaide, South Australia 5000

Abstract

Two new taxa, *Ehretia grahamii* Randell and *Trichodesma zeylanicum* var. *grandiflorum* Randell, as well as a new combination *Ehretia saligna* var. *membranifolia* (R.Br.) Randell, are here published. In addition, the nomenclature of Australian material of *Amsinckia* is discussed.

1. **Ehretia saligna** R.Br. var. **membranifolia** (R.Br.) Randell, *comb. nov.*

Basionym: Ehretia membranifolia R.Br., *Prodr.* 497 (1810).
Type: Broad Sound, *R.Brown 102*, 25.ix.1802, n.v.

Shrub or tree to 8 m tall. *Leaves*: blades elliptic, broadly lanceolate to ovate, not falcate, 4-15 cm long, 6-60 mm wide, rarely drooping, ± chartaceous, green; petioles 5-20 mm long. *Inflorescences* terminal on short branchlets, spreading. *Flowers*: specimens either with hermaphrodite flowers, with exserted stigma but anthers almost enclosed in corolla tube; or with male flowers, having exserted anthers but ovary (aborted and drying black), style and stigma enclosed in corolla tube. *Fruit* red, succulent, drying black, splitting into 4 1-seeded nutlets. Peach bush.

Distribution and ecology

Occurs in northern Northern Territory, north-western Queensland and along the eastern highlands from northern Queensland to central New South Wales; usually restricted to vine scrubs, fringing forests or rainforest margins, in contrast to drier habitats occupied by the type variety.

Notes

Robert Brown described two species, *E. saligna* and *E. membranifolia*, based largely on leaf morphology. Bentham (1868) accepted these, but put emphasis on floral differences, describing one species with exserted anthers, the other with enclosed anthers. It is now obvious that these variations represent male and hermaphrodite flowers within a single taxon.

There is considerable variation in leaf morphology within this taxon. As part of the variation seems to be correlated with differing habitats, and the variation pattern is almost continuous, I consider that two separate species cannot be maintained. However, since field work has not been possible, it seems best to retain the two taxa originally described by Brown, at variety level. Future workers will need to re-examine this problem.

The key to varieties of *E. saligna*

Leaves linear to lanceolate, falcate .... var. *saligna*
Leaves elliptic to lanceolate to ovate, not falcate .... var. *membranifolia*

Selected specimens (about 50 seen)

NORTHERN TERRITORY: Gregory Natl Pk, *B.G.Thompson s.n.*, 26.ii.1986 (DNA); Tanumbirini station, *B.G.Thompson s.n.*, 22.ii.1988 (DNA).

QUEENSLAND: Lynd Scrub, W Mt Garnet, *L.J.Smith & J.G.Tracey s.n.*, 1962 (BRI, CANB); Hwy c. 130 km N Clermont, *L.G.Adams s.n.*, 12.vii.1964 (CANB, DNA).

NEW SOUTH WALES: "Iolanthe" c. 26 km SW Garah, *K.L.Wilson s.n.*, 2.x.1978 (BRI, NSW).

2. **Ehretia grahamii** Randell, *sp. nov.*

Folia insuper hispidis, subter pubescentibus. Inflorescentia densa globosa nunquam patens. Corolla campanulata. Nuculae 4.

Holotype: Pine Mountain, State Forest 79, *P.I.Forster 7998 & W.J.MacDonald*, 21.iv.1991 (BRI); iso: K, L, MEL, QRS.

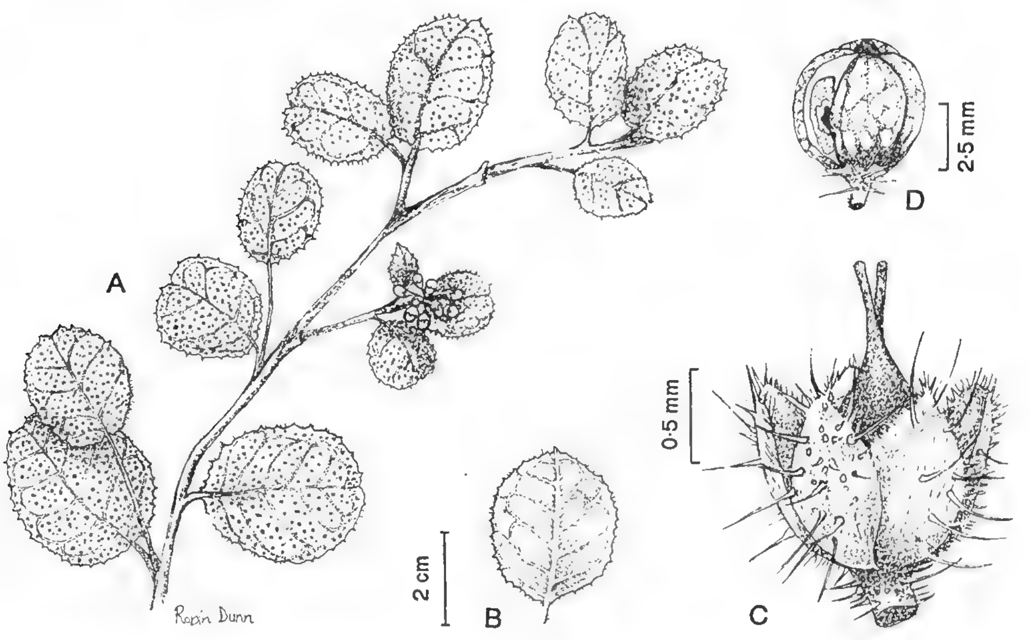

Fig. 1. *Ehretia grahamii* Randell. A, habit showing adaxial leaf surfaces; B, leaf, abaxial surface, both from *N. Gibson 793*; C, calyx with enclosed ovary and bifid style, from *E.R. Anderson s.n.*, 27.ix.1978; D, mature fruit of 4 nutlets, one in sectional view, from *K.A. Williams 82002*.

Shrub or small tree 1-3 m tall. *Branchlets* hairy. *Leaves*: blades elliptic, oblong or ovate, 1.5-6 cm long, 1-4 cm wide, entire, ± scalloped with margins revolute between veins, apex rounded to acute, bicolorous, densely hairy below, sparsely hispid above; petioles 3-5 mm long, hairy. *Inflorescences* dense, globular, terminal on short laterals 2 mm long, never expanding. *Calyx* 1.5 mm long, scarcely fused, lobes lanceolate acute. *Corolla* 3 mm long, campanulate; lobes 1 mm long, acute, strongly recurved. *Anthers* exserted, filaments 3 mm long, inserted 1 mm from

tube base. *Style* split almost to base; stigmas included. *Fruit* (only dry seen) corky, 5 mm diam., breaking into 4 nutlets, each apparently 1-seeded. Fig. 1.

Distribution and ecology

Occurs in softwood scrubs, dry rainforest or vine thickets between Proserpine and Rockhampton, Queensland, on reddish stony soil or light clay. Map 1.

Notes

Flowers in spring or autumn. Differs from the other Australian species in that the leaves are unusually small, and their upper surfaces have hairs which are spreading and rigid, with a prominent ring of white basal cells visible to the naked eye. It is apparently unique in bearing fruit on short branches which never elongate.

Relationships of this species are obscure. It has the leaf hairs and small flowers of *E. asperula* from Java and IndoChina (Johnston, 1951), but in that species the leaves are much larger, and the inflorescence branches are elongate in fruit. Among Australian species, *E. saligna* has larger flowers and larger glabrous leaves, and while *E. acuminata* does have small flowers, it has spreading inflorescence branches, large glabrescent leaves, and fruit splitting into 2 2-seeded nutlets.

I have named this species for my husband, as an indication of my deep affection.

Specimens examined

QUEENSLAND: Mt Britton mine, Homevale station, Nebo, *L.J.Webb & J.Tracey s.n.*, -.xii.1973 (BRI, QPS); 32 km S Lotus Ck, Bruce Hwy between Marleborough and Sarina, *K.A.Williams 82002*, 12.v.1982 (BRI); Percy Island, *G.Innes s.n.*, 13.xi.1981 (BRI); State Forest, Rundle Range, *N.Gibson s.n.*, 27.v.1985 (BRI, NSW) and 28.viii.1985 (BRI); Targinie, Mt Larcom Range, *N.Gibson 793*, 7.v.1986 (BRI).

3. **Trichodesma zeylanicum** (Burm. f.) R.Br. var. **grandiflorum** Randell, *var. nov.*

Frutex. Sepala lanceolata. Corolla campanulata, plerumque alba. Margo antherarum trichomatibus brevibus.

Holotype: Shaw Creek, 2 km downstream from Ayers Rock road, *T.S.Henshall 212b*, 7.ix.1978 (AD); iso: BRI, CANB, K, MEL, NSW, PERTH.

Shrubs 1-2 m tall. *Leaves* linear to lanceolate, 6-12 cm long, 3-15 mm wide. *Inflorescence* bracteate, of paired unbranched cymes, not greatly elongating after flowering . *Pedicels* barely exceeding bract length. *Calyx* lobes 15-20 mm long, not elongating in fruit. *Corolla* campanulate, 15-25 mm long, usually white or rarely blue; tube c. 2 mm long, expanding from base. *Anthers* exserted; terminal appendages of connectives (but not anthers) cohering by tangled lateral hairs. *Style* c. 15 mm long. Fig. 2.

Distribution and ecology

Of localised and dispersed occurrence from Carnarvon in Western Australia, to Docker River in Northern Territory, usually in sand. Flowers in spring. Map 2.

Notes

This taxon has been recognised as distinct for some time (e.g. Mitchell 1981) but has not previously been named. Mitchell considered it as probably of specific rank but I feel that

differences within the Australian materials are not of the same magnitude as those used to recognise species elsewhere in the genus (e.g. Africa).

Australian material of *T. zeylanicum* contains three recognisable forms. Mitchell did not recognise var. *latisepalum* F. Muell. ex Benth. in Central Australia, but in more northern areas its consistently cordate sepals and preference for clay or rocky substrates make it distinctive.

The remaining varieties *zeylanicum* and *grandiflorum* both have lanceolate sepals and are found in sandy soils. However, only once have they been recorded growing in association. The type variety is usually of a more herbaceous habit, with blue rotate corollas; while var. *grandiflorum* has a more robust habit, and white flowers which are campanulate (perhaps correlated with the shorter lateral hairs of the anthers).

The variety name *grandiflorum* describes its larger flowers.

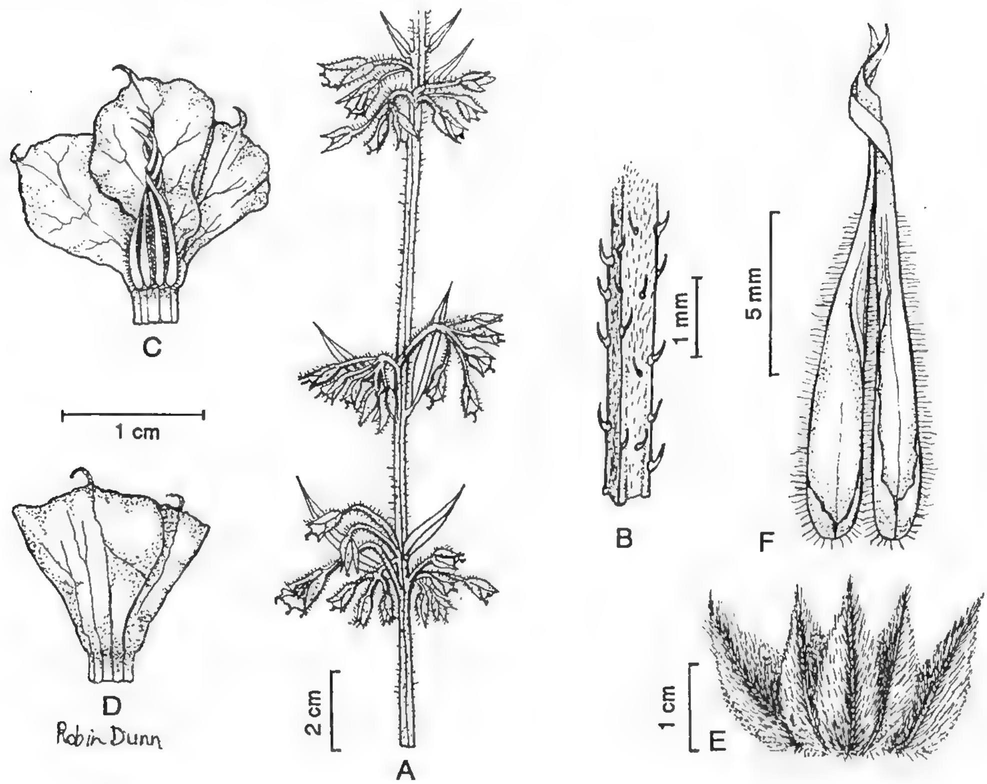

Fig. 2. *Trichodesma zeylanicum* var. *grandiflorum* Randell, all from *T.L. Setter 269*, except D, which is from *E.N.S. Jackson 2952.* A, inflorescence showing paired branches and short pedicels; B, detail of hairs of stem; C-D, campanulate corolla, internal and external views; E, dissected calyx showing lanceolate lobes; F, 2 anthers, showing short marginal hairs.

Selected specimens (about 30 seen)

WESTERN AUSTRALIA: c. 70 km NNE main Wittenoom to Newman road, *E.N.S.Jackson 2952*, 21.viii.1977 (AD, NSW, TI); Carnarvon (W.A.), *A.Ashby 5529*, 12.viii.1977 (AD, BRI, CBG, HO, NSW).

NORTHERN TERRITORY: Petermann Ras., at crossing of Docker River road with Docker R., just E of township, *M.G.Corrick 10405*, 23.vii.1988 (AD, CANB, DNA.)

Map 1. *Ehretia grahamii* Randell. **Map 2.** *Trichodesma zeylanicum* var. *grandiflorum* Randell.

4. **Amsinckia** complex

This genus occurs naturally in North and South America, but at least two species have been introduced to Australia, where they now comprise important weeds of grain crops in southern areas of all mainland states. In most states they are declared pest plants, reportedly toxic to animals (Everist 1981).

There is a problem in determining which specific name(s) should be used here. Previous treatments have separated the Australian material into 2 (in the *Flora of South Australia*) or 3 (in the *Flora of South East Qld*) species. I here cite the key to species given in the latter (Stanley 1986).

1. Corolla throats constricted and closed by intruding hairy saccate processes; stamens inserted low in corolla tube .... 1. *A. lycopsoides*
1. Corolla throats open or glabrous; stamens inserted in throat
   2. Corollas orange to orange-yellow, conspicuously exserted beyond calyx; stems strigose only, often almost glabrous .... 2. *A. intermedia*
   2. Corollas pale yellow, usually scarcely exserted from calyx; stems hairy as well as strigose .... 3. *A. calycina*

My investigations have revealed a complex biological problem in Australia. While there is variation in flower structure (colour, length and constriction in the corolla tube, length of style, position of anthers) I have not been able to recognise consistent patterns of variation. I am thus forced to recognise only a single complex, not the 2 or 3 species of earlier authors.

American workers (Ray & Chisaki 1957) report that only one species (*A. lycopsoides* Lindley ex Lehm.) has hairy protuberances (crests) in the throat of the corolla tube. *A. lycopsoides* is also unique in regularly having anthers inserted almost at the base of the corolla tube, just above a short constriction. Some Australian plants certainly have low anthers above a constriction, and large crests in the throat, and are thus identifiable as *A. lycopsoides*.

However, in other Australian plants the crests, though present, are smaller, and the hairs are sparse or absent. Anthers are not always at the base of the tube. I have not been able to equate plants having both (small) crests and anthers high in the tube, with any American taxon.

Previous Australian treatments of plants without crests or hairs in the throat have referred them to either *A. calycina* [from S. America] or *A. intermedia* [from N. America]. Unfortunately no recent American author has discussed both these taxa, but comparison of older descriptions (e.g Johnston 1927 and Munz 1974) suggests they are very similar. The relationship between these species will have to be clarified in America, before the identity of Australian material can be established.

Both of these uncrested species are described as having anthers at the throat of the tube. Some Australian plants certainly match this description, and are thus referable to *A. intermedia/calycina*. However, there are other Australian plants where the anthers are low in the tube. Once again, I have been unable to equate this material (uncrested, anthers low in the tube) with any American taxon.

While simple interspecific hybridization probably explains this situation, the occurrence elsewhere in the genus of heterostyly, and also possibly asexuality, indicates that other possibilities should be considered.

Ray and Chisaki (1957) reported outcrossing in some species (apparent hybridization of *A. intermedia* with *A. lycopsoides* Lindley ex Lehm.), and heterostyly in others. Charles Darwin (1877) demonstrated the occurrence of either asexuality or selfing in this taxon [*A. spectabilis* sensu Gray = *A. douglasiana* sensu Macbride = *A. intermedia* Fischer & Meyer = *A. lycopsoides* s.l., see Johnston, (1935)].

Heterostyly has not been recorded for these species in America, but could be operating here. Australian plants do show considerable variation in style length and position of anther insertion. Buds are apparently uniform with the stigma positioned beyond the anthers. The latter are carried upwards as the corolla expands, but their final position probably depends on the degree of corolla expansion.

At maturity of uncrested flowers, the anthers are usually positioned just below the throat of the corolla tube, and the stigma is almost level with them. In a number of cases the style is somewhat below the anthers [the 'thrum' state], and rarely the stigma is still above the anthers [the 'pin' condition]. But in a significant proportion, the anthers remain low in the tube with the stigma at almost the same level, as is the case in *A. lycopsoides*.

It is obvious that breeding system studies are needed to determine the cause of the breakdown of taxonomic distinction in Australia, whether hybridization, asexuality or heterostyly. This would probably also shed light on the identity of the taxa involved.

Vegetatively, there is little variation in the Australian material and in view of the reproductive uncertainties outlined above, I have chosen to treat this as a single complex. It may be helpful to future workers to record that Dr. P. Ray was previously known as Dr. Kamb, and H.F. Chisaki later became Mrs Hommersand (D.J.Connor, in litt., NSW).

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A REVIEW OF THE USE OF *EREMOPHILA* (MYOPORACEAE) BY AUSTRALIAN ABORIGINES

G.S. Richmond

School of Environmental Biology, Curtin University of Technology,
GPO Box 1987, Perth, Western Australia 6001

Abstract

Traditional uses of the desert shrub *Eremophila* by Aborigines have been documented. Historically, this desert genus has been valued for medicinal and cultural purposes by Aboriginal people in both coastal and central Australia, with *E. alternifolia* and *E. longifolia* the most significant species. Seventeen species have been used for a range of medical purposes. These ranged from fever, headaches, rheumatism, general well-being, scabies, to the initiation of mothers' milk after childbirth. *Eremophila* species were also utilised during ceremonial rites, initiations, as a form of display after battle and as a shroud during the burial ceremony. Some species were also used as a minor source of food. In Australia today, *Eremophila* species are regarded as either an invasive woody weed or as a shrub with horticultural potential.

Introduction

Much has been written in the past on traditional uses by Aborigines of the flora and fauna of Australia (Meggitt 1962). Early accounts of the first explorers and settlers penetrating the hinterland offer an understanding, not only of Aborigine culture but also European man's attitudes and conceptions of Aboriginal tribal life (Chewings 1936, Gillen 1968, D.F. & L.D. Satterthwait 1983). Many of these accounts are compilations of uses for a range of flora and fauna. However, in terms of plant uses, much of the original detail has been omitted or forgotten. For instance, little detailed information has been compiled on the desert shrub and small tree, known as *Eremophila*, even though it is one of the most widely distributed and diverse genera within Australia. Chinnock (*pers. comm.*) has recognised 210 species, of which 76 species are still to be described. Recent attention has focused on these shrubs because they are decorative and suitable for growing in low rainfall areas. Many are characterised by their spectacularly coloured flowers and calyx, and for this reason many are now used horticulturally (Chinnock 1982, Elliot and Jones 1984). Furthermore, these species offer an opportunity for revegetation programs. However, in the pastoral context some species are regarded as an invasive woody weed such as *E. sturtii* (Kerosene Bush) in New South Wales (Condon 1972) or as poisonous plants e.g. *E. maculata* (Emu Bush), which should be controlled (Everist 1981).

Eremophila species are locally dominant in the semi-arid and arid zones of Australia, and are characterised by their drought, fire, frost and grazing tolerances (Frazier 1965, Latz 1982, Mitchell and Wilcox 1988). Indeed, in many harsh environments where few shrubs prosper, these shrubs are often found flourishing. Many occur on impoverished soils or are indicative of degraded rangelands. As a consequence they are often collectively termed Poverty Bush in Western Australia, though Emu Bush is a common name used in the other states and territories of Australia. This aforementioned name is due to emus favouring the fruits as a food source (Davies 1978). Because they are widespread, many Aboriginal tribes have utilised them, primarily for their medicinal properties, as well as for cultural rites. They were also used as a minor food source by tribal Aborigines throughout arid Australia. This paper outlines in detail these traditional, cultural and food uses of *Eremophila* species.

Traditional medicinal uses of *Eremophila* species

Of all the *Eremophila* species throughout Australia *E. alternifolia* (Native Honeysuckle) appears to be the most important and is still considered by the old Aboriginal people as the "number one medicine" (Barr 1988). It is used both internally and externally, as a decongestant,

expectorant and analgesic, and for inducing general well-being. Because this shrub was considered as a general remedy, it was one of the few plants which the Aborigines often dried and stored, carrying the leaves with them in case of need (Low 1990). It is highly aromatic (Latz 1982), fenchone being the major constituent of its essential oil fraction (Barr 1988, Low 1990). The ailments reportedly cured by this shrub ranged from colds, influenza, headaches and fever, to relieving internal pain, cleansing septic wounds and encouraging deep sleep and pleasant dreams (Bowen 1975, Smith 1991, Tindale 1937). A detailed summary of medicinal uses of *Eremophila* species is shown in Table 1.

Species	Plant part	Preparation	Purpose	References
E. alternifolia	Leaves	Infusion/Ingested	Deep sleep	Tindale 1937
	Leaves	Decoction	Colds, influenza, headaches	Smith 1991
	Leaves	External	Internal pain	Barr 1988
	Leaves	External	Septic wounds	Bowen 1975
	Leaves	Body wash	Fever	Smith 1991
E. bignoniiflora	Leaves	Decoction	Laxative	Bowen 1975
	Fruits	Ingested	Purgative	Bowen 1975
E. cuneifolia	Leaves	Decoction	Colds	Lassak & McCarthy 1983
E. dalyana	Leaves	Body rub	Relieve chest pains	Latz 1982
	Leaves	Decoction	Body wash for scabies	O'Connell 1983
E. duttonii	Plant	Unknown	Unknown	Hale 1975; Meggitt 1962
	Leaves	Antiseptic wash	Sores, cuts, influenza, eye/ear	Smith 1991
	Leaves	Decoction	Sore throat	Barr 1988
E. elderi	Plant	Unknown	Unknown	Latz 1982
	Leaves	External	Bedding/head rest/colds	O'Connell 1983
E. fraseri	Leaves	Unknown	Unknown	Reid & Betts 1979
	Leaves	Decoction	Colds	Lassak & McCarthy 1983
	Plant	Unknown	Toothache and rheumatism	Lassak & McCarthy 1983
E. freelingii	Leaves	Decoction	Headaches and chest pains	Cleland & Tindale 1959
	Leaves	Decoction	Antiseptic wash for sores	Smith 1991
	Leaves	Infusion	Colds	Latz 1982
	Leaves	Decoction	Aches and pains	Low 1990
	Leaves	Decoction	Antidiarrhoea	Barr 1988
	Leaves	Infusion	Headache and rest	Lassak & McCarthy 1983
	Leaves	External	Pillow to promote rest	Meggitt 1962
	Leaves	Infusion	General well-being	Latz 1982
E. gilesii	Leaves	Decoction	Headaches and chest pains	Cleland & Tindale 1959
	Leaves	Body wash	Sores	Tynan 1979
	Leaves	Infusion	Colds	Latz 1982
	Leaves	Pillow	Promote rest	Latz 1982
	Leaves	Infusion	General well-being	Latz 1982
E. goodwinii	Leaves	Decoction	Purgative	Latz 1982
E. latrobei	Leaves	Decoction	Body wash for scabies	Cleland & Tindale 1959
	Leaves	Infusion	Used to "smoke babies"	Meggitt 1962
	Leaves	Decoction	Colds	Smith 1991
	Leaves	External	Colds & influenza	Smith 1991

E. longifolia	Leaves Leaves Leaves Leaves Leaves Leaves/twigs/bark	Decoction Infusion Decoction Infusion Decoction Infusion	Skin/body/wash "Smoke" mothers/new born babies Eye wash Colds Counter-irritant Headache	Silberbauer 1971 Cleland & Johnston 1933, 1937a O'Connell 1983 Spencer & Gillen 1969 Tynan 1979 Spencer & Gillen 1969
E. maculata	Leaves	Poultice	Colds	Cunningham et al. 1982
E. mitchellii	Twigs	Smoke	General medicinal purposes	Low 1990
E. neglecta	Leaves	Infusion	General well-being	Latz 1982
E. paisleyi	Leaves/twigs	Decoction	Wash for scabies	Latz 1982
E. sturtii	Branches Shrub Leaves Leaves Leaves	Infusion Burnt ashes Decoction Infusion Decoction	Backaches Backaches Sores and cuts Head colds and sore eyes Antidiarrhoea	Silberbauer 1971 Bowen 1975 Smith 1991 Barr 1988 Barr 1988

Table 1. Medicinal uses of *Eremophila* species by Aborigines

O'Connell *et al.* (1983) comments that the Alyawarra people of Central Australia used *E. dalyana*, *E. duttonii* (Red Poverty Bush), *E. elderi*, *E. freelingii* (Native Fuchsia), *E. gilesii* (Green Turkey Bush), *E. latrobei* (Warty Leafed Eremophila) and *E. longifolia* (Berrigan) for their medicinal properties. Of these, *E. longifolia* appears to be the most important. It is widespread throughout continental Australia except for the extreme north. It is a tall and erect shrub or small tree (up to six metres high) typified by drooping branches and globular dark coloured fruits. Indeed, it is known as Native Plum or Weeping Emu Bush for the aforementioned reasons (Cribb and Cribb 1981, 1982). *E. longifolia* played an important role during the very early life of an Aboriginal infant. Some days after the child's birth, the child is placed in a wooden trough made from the Stuarts' Bean tree i.e. *Bauhinia carronii* (Irvine 1957) on a bed of finely powdered bark of the former. Dry kindling is placed in the bottom of a freshly dug trench and green twigs of *E. longifolia* are spread. The mother and child sit in the trench where these twigs are being burnt. The fumes of the burning wood are inhaled (Chewings 1936), and this is considered to strengthen the baby and stop the mother's bleeding (Latz 1982). Similar uses have also been recorded for *E. latrobei* (Meggitt 1962). Chewings (1936) also notes that the grandmother of the infant takes a burning twig in her hand and passes it over the face and upper part of her daughter-in-law's body, to increase the mother's milk-supply. The leaves, twigs and bark were used as a decoction to cure headaches and an infusion of leaves was applied to sore eyes, boils and for insomnia (Low 1990). A decoction was applied to sores and also drunk for colds (Lassak and McCarthy 1983) and used by the Walbiri tribe as a counter-irritant (Tynan 1979). The leaves and bark contain tannins, whilst the leaves contain an essential oil rich in safrole and methyleugenol (Della and Jefferies 1961).

The leaves of *E. freelingii* were utilised primarily as an antiseptic wash though aches and pains, headaches, diarrhoea, sores and chest pains were also treated (Barr 1988; Cleland and Tindale 1959; Lassak and McCarthy 1983; Low 1990; Smith 1991). Meggitt (1962) states that the leaves of *E. freelingii* were used as a pillow, whilst an infusion of leaves was taken for general well-being (Latz 1982). It is also one of the few Aboriginal remedies adopted by whites who brewed medicinal tea from the fragrant leaves which contain mostly alphapinene (Barr 1988; Low 1990).

E. dalyana, E. duttonii, E. gilesii and *E. latrobei* were all utilised primarily as a body rub, to alleviate chest pains and scabies (Tindale 1959, Tynan 1979; Cleland and Latz 1982;). One use of *E. duttonii*, was as a fly repellent (Smith 1991) and has resulted in the Aranda tribe naming it

Kangaroo Rolling because of the frequent incidences of kangaroos rolling around in this shrub, supposedly to reduce the intensity of insect attack. Silberbauer (1971) comments that because *E. sturtii* has fly-repellent qualities, its branches were used by early European man to thatch meat-houses. Tynan (1979) details the preparation of *E. gilesii* (by the Walbiri people of Alice Springs) which consisted of drying the fine leaves and then mixing them with fat or alternatively making a solution by soaking the leaves in water for a day. It is then used to rub on sores though when it is "made like tea" it may also be drunk for a cold. Of interest are the uses of *E. bignoniiflora* (Gooramurra) and *E. goodwinii* (Purple Fuchsia Bush) as purgatives. In the case of *E. goodwinii* the leaves were prepared as a decoction (Latz 1982) whilst for *E. bignoniiflora* the fruits were eaten. Bowen (1975) states that this remedy was only utilised in drastic cases of sickness. Of minor importance were species such as *E. mitchellii* (False Sandalwood) whose twigs were burnt to promote a feeling of general well-being, while *E. elderi* provided bedding material respectively (Table 1).

Cultural uses of *Eremophila* species

Eremophila species have played a role in the ceremonial life of Aboriginal people (Table 2). Of all the species utilised, *E. longifolia* appears to be of special significance for Central Australian Aborigines, and is considered to be the most sacred and mystical of all Central Australian plants (Latz 1982). The leaves and branches were used in elaborate circumcision rites where small sprigs were placed in headbands and armbands of the novices. Dances were performed, such as one known as the Quabara Akakia (Plum Tree), which occurred at Iliakilia in the Waterhouse Range in Central Australia. Quabara was the name applied generally to the sacred ceremonies which only initiated men may witness and take part in (Spencer and Gillen 1969). This event would be followed by singing for several hours and then the young men allotted for initiation were decorated with twigs and leaves which were placed in their headbands. This material was known as wetta, and would be worn until the end of the ceremony. According to Spencer and Gillen (1969) this plant played an important role in the Engwura ceremony, which was a series of ceremonies attendant upon the last rites concerned with initiation. In other ceremonies, the foliage was heated to produce acrid smoke. Leaves were also used to brush sacred objects and bodies of men during rituals, whilst the branches were used to line graves and shroud bodies (Meggitt 1962; Spencer and Gillen 1969; Strehlow 1968). The Northern Aranda people of Central Australia permitted water to be collected from sacred waterholes only if fresh *E. longifolia* branches were held upon approaching the site and laid down near the water's edge. This was done to please the totemic ancestor Karora (Strehlow 1968, 1971), who was lying in eternal sleep at the bottom of the Ilbalintja Soak. During the Spencer and Gillen Expedition to Central Australia during 1901 - 1902, the use of *E. longifolia* branches by Aranda people was documented during an Atninga (war party) in Central Australia. In this instance Gillen (1968) notes that a murder was committed by an Aborigine who had come to a locality in the form of a Kurdaitcha, the name applied to a man who has gone out on his own initiative, wearing emu-feather shoes to kill an individual accused of having injured someone by magic (Spencer and Gillen 1969).

This person pointed a bone at the wife of a tribal member, causing her great suffering and death. As a consequence a war party was gathered, and when unable to find the man who had committed the crime, killed his father (an old man) because he was aware of his son's malicious intentions but did nothing to stop him. Twigs of *E. longifolia* adorned the armlets, forehead bands and the nose septum of the returning war party to signify the death of an enemy. On returning to their camp members of the war party danced fully armed up the bed of a river, with a characteristic high knee action, whilst they displayed the foliage of the shrub. Other uses of *E. longifolia* involved tanning water bag skins with extracts from the bark (Bowen 1975).

Species	Plant part	Preparation	Purpose	References
E. fraseri	Leaves	Decoction	Resinous extract for cementing	Cribb & Cribb 1982
E. freelingii	Flowers	External	Ceremonial purposes	Cleland & Johnston 1937a
E. longifolia	Leaves	Infusion	Ceremonial rites	Gillen 1968
	Branches	Infusion	Blacken artefacts/bodies in rituals	Hale 1975
	Twigs	Funeral rites	Line graves & shrounding bodies	Meggit 1962
	Branches	Ceremonial	Placed in headbands	Latz 1982; Strehlow 1968, 1971
	Leaves	Ceremonial	Initiation	Meggitt 1962
	Bark	Extract	Tanning water bags	Bowen 1975
E. mitchellii	Wood	Raw	Carvings	Cribb & Cribb 1982
E. oppositifolia	Bark	Extract	Tanning water bottles	Cribb & Cribb 1982; Bowen 1975

Table 2. Cultural uses of *Eremophila* species by Aborigines

Many *Eremophila* species, such as *E. fraseri* (Turpentine Bush) of Western Australia, in common with other desert-adapted species such as *Acacia* (Mulga), *Triodia* (Spinifex) and *Xanthorrhoea* (Grass Tree), produce copious quantities of a resinous exudate which accumulates on the leaves and branchlets. These resins were collected by the Aboriginal people and used as sealants and adhesive materials (Cribb & Cribb 1982). In Queensland *E. mitchellii* was used for carvings (Cribb & Cribb 1982) whilst on a more practical basis Bowen (1975) notes that a bark extract of *E. oppositifolia* (Weeooka) was used in tanning water bottles. Of minor importance was the use of flowers, such as *E. freelingii* for ceremonial purposes (Cleland & Johnston 1937a). The flowers are tubular, whitish, lilac, lavender to pale blue (Elliot & Jones 1984) and adorned the headbands (Cleland & Johnston 1937a).

Eremophila species as sources of food

Few *Eremophila* species were considered important as food. The flowers and leaves of *E. freelingii* and *E. latrobei* (Table 3) were utilised by the Walbirri tribe of the Northern Territory, and, it is known that the nectar of the flowers was drunk and regarded as a delicacy. Irvine (1957) regards these nectars primarily as famine foods. Little is known of the actual preparation of the leaves of the aforementioned shrubs (Meggitt 1962). Indeed, Meggitt (1957) comments that edible leaves form but a minute part of Aboriginal diets. Nevertheless, leaves of *E. longifolia* were used in the cooking process, to surround emu flesh thus giving it an aromatic flavour (Smith 1991), presumably produced by the fenchone which is abundant in the essential oil. Fruits are also reputedly food for emus (Cleland & Tindale 1954). Of secondary importance were green caterpillars, known as Tnurujatja by the Aranda people of Central Australia, which were collected from the twigs of this shrub and eaten (Strehlow 1968). Though *Eremophila* fruits were not eaten, fruits of another member of the Myoporaceae, *Myoporum damperi* (=*M. montanum*) (Spencer 1896) were consumed.

Species	Plant part	Preparation	Purpose	References
E. freelingii	Leaves	Decoction infused	Tea substitute	Silberbauer 1971
	Leaves	Infused	Sugar substitute	Silberbauer 1971
	Flowers/leaves	Unknown	Unknown	Meggitt 1962
E. latrobei	Flower	Raw	Nectar as food delicacy	Cleland & Johnston 1933, 1937b
	Flowers/leaves	Unknown	Unknown	Meggitt 1962

E longifolia	Leaves	Raw	Flavour emu fat when cooking	Smith 1991
	Twigs	Unknown	Green caterpillar found on leaves	Cribb & Cribb 1982

Table 3. Food uses of *Eremophila* species by Aborigines

Conclusions

Eremophila is an important desert genus which is widely utilised by Aborigines in Australia. Early into the life of an Aborigine, *Eremophila* plant parts were utilised, as illustrated by the use of cleansing a new born child with the infusion of leaves (*E. longifolia*) to strengthen it for life's struggles ahead. Throughout an Aborigines' life, *Eremophila* shrubs would be sought for their medicinal qualities. During tribal movements, dried foliage of *E. alternifolia* may be found amongst the few possessions carried in case of emergencies. They were incorporated in cultural rites, as well as for the worship of their feared and loved totemic ancestors, whom they were propitiating and whose goodwill they were drawing upon themselves by carrying out these traditional rites (Strehlow 1971). For the young Aboriginal male, *Eremophila* species were used in the elaborate and complex ceremonies which took him from boyhood to manhood. Finally in death, *Eremophila* species were involved in ceremonial rites, with branches lining the graves and shrouding the bodies during the burial ceremony.

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A TAXONOMIC REVISION OF THE GENUS *PHYLA* LOUR. (VERBENACEAE)* IN AUSTRALIA

Ahmad Abid Munir

State Herbarium, Botanic Gardens, North Terrace, Adelaide, South Australia 5000

Abstract

A taxonomic revision of the genus *Phyla* in Australia is presented. The following two species are recognised: *P. nodiflora*, and *P. canescens* which is recorded from Australia for the first time. Affinities and distribution are considered for the genus and each species. A key to the species is provided and a detailed description of each is supplemented by a habit sketch of a flowering branch and analytical drawings of the flowers.

Taxonomic history of the genus

The genus *Phyla* was proposed by Loureiro (1790) with one species, *P. chinensis*, the type of which came from Cochinchina. It was placed in "Tetrandria Monogynia" where it was retained by Roemer & Schultes (1818), Sprengel (1825) and Dietrich (1839). With the exception of Loureiro (1790), all the above named authors referred this genus to the family Proteaceae. In 1805, Jaum Saint-Hilaire proposed the family Primulaceae for *Phyla*, which was later accepted for the genus by Hedwig (1806) and Reichenbach (1828). Endlicher (1840) recorded this genus in the appendix of his "Genera Plantarum" under "Genera dubiae sedis et non satis nota". Almost half a century later, Greene (1899) for the first time referred this genus to the family Verbenaceae and clearly distinguished between *Phyla* and *Lippia*. The entity of *Phyla* as a genus distinct from *Lippia* was accepted by Wooton & Standley (1915), Moldenke (1939, 1940, 1940a & thereafter), Burbidge (1963), Meikle (1963), Lopez-Palacio (1974, 1977), Munir (1983, 1986) and several others. Within Verbenaceae, the subfamily Verbenoideae, tribe Lantaneae was accepted for the genus by Moldenke (1959, 1971), Lopez-Palacio (1977), Munir (1983), Raj (1983) and a few others. Many botanists, however, have retained this genus in the Verbenaceae without reference to any subfamily or a tribe.

Prior to the above history of the genus, at least two *Phyla* species were described by Linnaeus (1753) as *Verbena*. Of these two species one each was later transferred by Michaux (1803) and Kunth (1818) to *Lippia*. Since then, most *Phyla* taxa have been widely recognised as *Lippia* species. In 1840, Meisner placed *Phyla* in the synonymy of *Lippia* and referred the latter to the tribe Lippieae in the Verbenaceae. The tribe Lippieae for the *Phyla-Lippia* assemblage was later accepted by Walpers (1845). The majority of other botanists also accepted *Phyla* as a synonym of *Lippia* but referred the *Phyla-Lippia* assemblage to different tribes. For instance, Dumortier (1829) divided the Verbenaceae into two tribes Verbeneae and Viticeae with *Lippia* (s.l.) under the tribe Verbeneae. This tribe was accepted for *Lippia* s.l. (or *Phyla-Lippia* assemblage) by Bentham (1839, 1870, 1876), Spach (1840), Schauer (1847), Miquel (1858), Thwaites (1864), Bailey (1883, 1901, 1913), C.B. Clarke (1885), Durand (1888), Post & Kuntze (1904), King & Gamble (1909), Ridley (1923), Gardner (1931), Lemée (1943) and several others. In 1895, Briquet re-classified the Verbenaceae and upgraded the tribe Verbeneae to a subfamily Verbenoideae. The latter consisted of six tribes with *Lippia* s.l. (including *Phyla*) in the tribe Lantaneae. This classification was adopted by Dalla Torre & Harms (1904), H.J. Lam (1919) and Junell (1934). The majority of botanists who accepted *Phyla* as a synonym of *Lippia* retained the latter in the Verbenaceae without reference to any subfamily or a tribe.

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* The present treatment of the genus *Phyla* is the twelfth in the series of taxonomic revisions in the family Verbenaceae in Australia. (See Munir, 1982, 1984a, 1984b, 1985, 1987a, 1987b, 1989, 1990a, 1990b, 1991, 1992.)

Australian history of the genus

The first Australian records of *Phyla* as circumscribed here (then under the names *Lippia* or *Zapania*) were collected by Robert Brown during 1802 - 1805 from Shoalwater Bay, Queensland. Then more specimens were collected from the same State by F.W.L. Leichhardt during 1843, T.L. Mitchell during 1847, John McGillivray during 1848, Amalie Dietrich during 1863 - 1865, John O'Shanesy during 1867 and a few others. In 1859, Augustus Oldfield collected it from Port Gregory in Western Australia. The first written record of this genus in Australia was published by Robert Brown (1810) under the name *Zapania*, which is now a synonym of *Phyla*. Later, F. Mueller (1868, 1875, 1882, 1889) recorded it as *Lippia* which name was later accepted for the genus in Australia by Bentham (1870, 1876), Bailey (1883, 1901, 1913) and others. In 1917, Ewart & Davies for the first time recorded *Lippia nodiflora* (now *Phyla nodiflora*) from the Northern Territory. This record was based on one of F. Mueller's (s.n.) collections from Victoria River gathered during the second half of the 19th century. In 1930, Ewart for the first time recorded this genus from Victoria. It was based on one of Tovey's (s.n.) collections from Williamstown acquired in January 1914. The first record of *Phyla* (then called *Lippia*) from South Australia was published by J.M. Black in his Flora of South Australia in 1929. It was based on one of J.M. Black's (s.n.) collections from the banks of Torrens Lake gathered on 5th January 1929. Since then many more records of this genus have become available from all mainland states in Australia.

In 1870, Bentham published a complete account of the Australian Verbenaceae, and listed two *Lippia* (s.l.) species namely *L. nodiflora* and *L. geminata*. Of these two species, the former belongs to the genus *Phyla* and the latter to *Lippia* (s.str.). Later, Moldenke (1959, 1971, 1980) recorded from Australia only one species, *Phyla nodiflora* with two varieties viz. var. *longifolia* Mold. from Queensland and New South Wales and var. *reptans* (Kunth.)Mold. from the Northern Territory. So far, all regional or mainland state floras in Australia have recorded only one *Phyla* species, *P. nodiflora*. In the present revision of *Phyla* in Australia, the following two species are recognised: *P. nodiflora* and *P. canescens*. *P. nodiflora* var. *longifolia* is found to be a long-leaved form of the typical variety, and the occurrence of *P. nodiflora* var. *reptans* in Australia has not been confirmed.

Chromosome numbers

The majority of available chromosome counts are reported from *P. nodiflora* of which the known count (2n = 36) was based on material from outside Australia. This count was first reported by Covas & Schnack (1946) and subsequently reconfirmed and/or recorded by Darlington & Wylie (1955), Sharma (1970), Fedorov (1974), Bir & Sidhu (1980), Navaneetham et al. (1982), Sidhu & Bir (1983) and others. According to Choudhary & Roy (1983), however, "the somatic complement in root tip of *P. nodiflora* showed thirty two chromosome" i.e. 2n = 32. Apparently, this count has not been confirmed. Besides *P. nodiflora*, Fedorov (1974) has given chromosome counts of an additional 3 *Phyla* species each with 2n = 36 chromosomes. The chromosome number 2n = 36 in the genus *Phyla,* therefore, seems to be generally consistent as contrasted with *Clerodendrum* L. where the counts show a wide range of chromosome numbers from 24 to 184.

PHYLA Lour.

Phyla Lour., Fl. Cochinch. edn 1 (1790) 66; J. St. Hil., Expos. Fam. Natural. 1 (1805) 223; Hedwig f., Gen. Pl. (1806) 366; Roemer & Schultes, Syst. Veg. III (1818) 28, 447, n. 562; Sprengel, Syst. Veg. 1 (1825) 487; Reichb., Consp. Reg. Veg. (1828) 82, n. 1770; D. Dietr., Synop. Pl. 1 (1839) 424, 540; Endl., Gen. Pl. 2 (1840) 1330, n. 6871; Steudel, Nomencl. Bot. 2 (1841) 325; L. Pfeiffer, Nomencl. Bot. 2 (1874) 690; E. Greene, Pittonia 4 (1899) 45; Wooton & Standley, Fl. New Mexico Contr. U.S. Natl. Herb. 19 (1915) 550; Mold., Lilloa 4 (1939) 295;

Mold., Bot. Maya. Publ. Carnegie Inst. Wash. No. 522 (1940) 169; Mold. in Pulle (ed.), Fl. Suriname (1940) 270; A.D.J. Meeuse, Blumea 5 (1942) 69; Mold. in Humbert, Fl. Madagascar (1956) 3, 12; Résumé, Verbenac. etc. (1959) 237, 276, 309, 329, 335, 393, 406; Burb., Dic. Aust. Pl. Gen. (1963) 230; Meikle in Hepper (ed.), Fl. W. Trop. Afr. edn 2, 2 (1963) 435; Backer & Bakh.f., Fl. Java 2 (1965) 597; Mold. in Wiggins & D. Porter, Fl. Galáp. Isl. (1971) 494; Mold., Fifth Summary Verbenac. etc. 1 & 2 (1971) 396, 397, 472, 476, 527, 548, 593, 602, 603, 735, 737, 753; Mold., Ann. Missouri Bot. Gard. 60 (1973) 59; Jafri & Ghafoor, Fl. W. Pak. No. 77 (1974) 10; Lopéz-Pal., Revista Fac. Farm. Univ. Los Andes Merida No. 15 (1974) 70; Lopéz-Pal., Fl. Venezuela (1977) 481; Mold., Phyt. Mém. II, Sixth Summary Verbenac. etc. (1980) 375, 395, 419, 462, 463; Baines, Aust. Pl. Gen. (1981) 283; Blackall & Grieve, W. Aust. Wildfl., edn 2, IIIB (1981) 394; S.W.L. Jacobs & Pickard, Pl. N.S.W. (1981) 209; Beadle et al., Fl. Syd. Reg. edn 3 (1982) 508; Mold. in Dassan. & Fosb., Fl. Ceylon 4 (1983) 235; Munir in Morley & Toelken, Fl. Pl. Aust. (1983) 288; Raj, Rev. Palaeobot. Palynol. 39 (1983) 363, 377, t. VI, 1 - 4; Beadle, Student's Fl. NE N.S.W., Part 5 (1984) 850; Munir in Jessop & Toelken (eds), Fl. S. Aust. Part III (1986) 1175; Stanley in Stanley & Ross, Fl. S.E. Qld 2 (1986) 366; Rimpl. & Sauerb., Chem. Syst. & Ecol. 14, no. 3 (1986) 307 - 309; Mabb., Pl. Book (1987) 449; Rye in N.G. Marchant et al., Fl. Perth Reg., Part 1 (1987) 551; Sykes in Webb et al., Fl. N.Z. 4 (1988) 1275.

Type species: P. chinensis Lour., Fl. Cochinch. edn 1 (1790) 66.

Platonia Raf., Med. Repos. 5 (1808) 352 [not Raf. 1810, nor *Platonia* Kunth 1829, nor Mart. 1829]—*fide* Moldenke (1983).
Type species: P. nodiflora (L.)Raf.

Diototheca Raf., Fl. Ludov. (1817) 74—*fide* Moldenke (1983).
Type species: D. repens Raf., *loc. cit.* (1817) 75.

Bertolonia Raf., Amer. Month. Mag. & Crit. Rev. 2 (1818) 267 [not *Bertolonia* DC. 1812, nor Moc. & Sessé 1825, nor Raddi 1820, nor Spinola 1809, nor Sprengel 1821]—*fide* Moldenke (1983).
Type species: ?B. crassifolia Raf.

Panope Raf., Fl. Tellur. 2 (1837) 103—*fide* Moldenke (1983).
Type: P. stoechadifolia (L.)Raf.

Piarimula Raf., Fl. Tellur. 2 (1837) 102—*fide* Moldenke (1983). Proposed as a substitute name for *Phyla* Lour.
Type: P. chinensis (Lour.)Raf.

Cryptocalyx Benth., Ann. Nat. Hist., Ser. 1, 2 (1839) 446; J. Bot. (Hooker) 2 (1840) 52; Endl., Gen. Pl. 2, Suppl. 1 (1841) 1401; Meisn., Pl. Vasc. Gen. part 2, "Commentarius" (1843) 366; Walp., Repert. Bot. Syst. 4 (1845) 57—*fide* Moldenke (1983).
Type: C. nepetaefolia Benth.

Lippia auct. non L.: sensu Michaux, Fl. Bor. Amer. 2 (1803) 15; Sprengel, Syst. Veg. 2 (1825) 751, *p.p.*; Reichb., Reg. Veg. (1828) 117, *p.p.*; Dumort., Anal. Fam. Pl. (1829) 22, *p.p.*; Endl., Gen. Pl. 1 (1836) 633, n. 3684, *p.p.*; Benth., Ann. Nat. Hist. 2 (1839) 445, *p.p.*; Meisner, Pl. Vasc. Gen. Vol. 1, "Tab. Diag." (1840) 290, *p.p.*; Vol. 2, "Commentarius" (1840) 199, *p.p.*; Spach, Hist. Nat. Veg. Phan. 9 (1840) 227, *p.p.*; Steudel, Nomencl. Bot. 2 (1841) 54, *p.p.*; Walp., Repert. Bot. Syst. 4 (1845) 42, *p.p.*, Schauer in A. DC., Prod. 11 (1847) 572, *p.p.*; Miq., Fl. Ind. Bat. 2 (1856) 905, *p.p.*; Thwaites, Enum. Pl. Zeylan. (1861) 241, *p.p.*; Benth., Fl. Aust. 5 (1870) 34, *p.p.*; Baker, Fl. Mauritius & Seych. (1877) 252, *p.p.*; Benth. in Benth. & Hook.f., Gen. Pl. 2 (1876) 1142, *p.p.*; F. Muell., Syst. Cens. Aust. Pl. edn 1 (1882) 102, *p.p.*; Bailey, Synop. Qld Fl. (1883) 376, *p.p.*; C.B. Clarke, Fl. Brit. Ind. 4 (1885) 563, *p.p.*; Th. Durand, Gen. Phan. (1888) 320, *p.p.*; F. Muell., Sec. Syst. Cens. Aust. Pl. 1 (1889) 171, *p.p.*; Briq. in Engl. & Prantl, Pflanzenfam. 4, 3a (1895) 151, *p.p.*; Bailey, Qld Fl. 4 (1901) 1171, *p.p.*; Dalla Torre & Harms, Gen. Siphon. (1904) 430, n. 7145, *p.p.*; Post & Kuntze, Lexic. Gen. Phan. (1904) 334, 688, *p.p.*; King & Gamble, Mat. Fl. Mal. Penin. 4, J. Asia. Soc. Beng. 74 (1909) 797, *p.p.*; H.J. Lam, Verbenac. Malay. Archip. (1919) 15, *p.p.*; Ridley, Fl. Mal. Penin. 2 (1923) 612, *p.p.*; Britton & P. Wilson, Sci. Surv. Porto Rico & Virgin Isl. 6 (1925) 141, *p.p.*; C. Gardner, Enum. Pl. Aust. Occ. part 2 (1930) 111, *p.p.*; P'ei, Mem. Sci. Soc. China 1, No. 3 (1932) 10, *p.p.*; Junell, Symb. Bot. Upsal. 4 (1934) 31, *p.p.*; Lemée, Dic. Descrip. Syn. Gen. Phan. 8b (1943) 653, *p.p.*; J.F. Macbr., Fl. Peru (1960) 644, *p.p.*; Haines, Bot. Bihar & Orissa, repr. edn, 2 (1961) 740, *p.p.*; Prain, Beng. Pl., repr. edn, 2 (1963) 615, *p.p.*; Britton, Fl. Bermuda (1965) 311, *p.p.*, excl. *L. triphylla* (L'Hér.)Kuntze; Gooding et al., Fl. Barbados (1965) 362, *p.p.*; T. Cooke, Fl. Pres. Bombay, repr. edn, 2 (1967) 499, *p.p.*; Gibson in Standley & Williams, Fl. Guatemala (1970) 206, *p.p.*; Adams, Fl. Pl. Jamaica (1972) 630, *p.p.*; Tutin in Tutin et al., Fl. Europ. 3 (1972) 123, *p.p.* excl. *L. triphylla* (L'Hér.)Kuntze; Howard, Fl. Lesser Antilles, Dicot. part 3 (1989) 232, *p.p.*

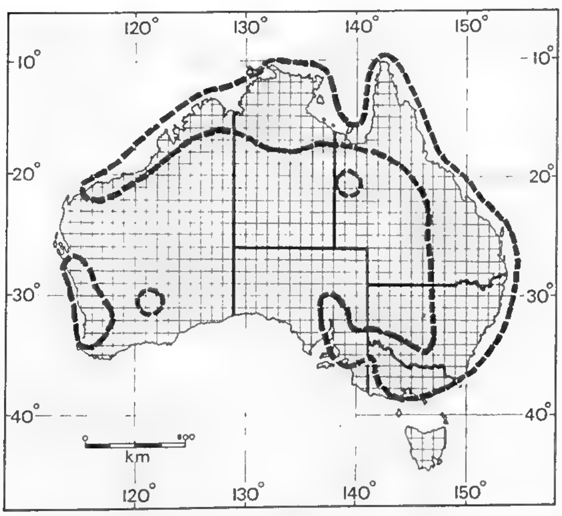
Perennial, usually procumbent or creeping herbs. *Stem* trailing or ascending, often rooting from the nodes, herbaceous, sometimes slightly woody at base, usually densely covered with appressed medifixed acute hairs. *Leaves* simple, decussate-opposite, often somewhat fleshy, serrate-dentate or sometimes almost entire, petiolate or subsessile. *Inflorescence* spicate, axillary, pedunculate, usually at first capitate-globose, later ovoid to oblong-cylindrical, densely many-flowered. *Flowers* sessile, zygomorphic, bisexual, hypogynous, each in the axil of a single bract; bracts often closely imbricate, cuneate-obovate or flabelliform. *Calyx* persistent, membranous, ovoid-campanulate or compressed, with 2 keels or wings and 2-lobed, each lobe either entire or 2-toothed (*P. nodiflora*), or the rim 2- or 4-fid or 4-dentate (*P. canescens*). *Corolla* hypocrateriform; tube cylindrical or slightly dilated upwards, straight or slightly curved; lobes obliquely sub-bilabiate, spreading, 4 - 5-fid, upper lip entire to 2-lobed, lower lip 3-fid. *Stamens* 4, didynamous, included or scarcely exserted; filaments short; anthers without appendages. *Ovary* bicarpellary, syncarpous, 2-locular, with 1 ovule in each locule; style short; stigma oblique, thick. *Fruit* a schizocarp, enclosed in fruiting-calyx, ellipsoid, compressed, splitting at maturity into 2 plano-convex one-seeded mericarps. *Seeds* without endosperm.

Number of species: World ± 11 species and several infraspecific taxa; Australia 2 species which were introduced and became naturalised.

Derivation of name

The generic name is derived from the Greek *Phylon*, meaning a tribe or race, also a swarm or school; probably in reference to the spreading mat-like growth of these species.

Distribution (Map 1)



Map 1. Distribution of genus *Phyla* in Australia

According to Moldenke (1940, 1973, 1983), Gibson (1970), Stanley (1986) and several other authors, the genus *Phyla* is widely distributed in "tropical" and "subtropical" America, with one or two species in the warmer parts of the Old World i.e. Asia and Africa. In Australia, however, it has also been recorded from the "temperate" areas.

So far only two naturalised species are found in the coastal and inland areas of mainland Australia. Of the two species, *P. nodiflora* is the most widespread in the whole genus and has been recorded from throughout the "tropics", "subtropics" as well as adjoining areas of both Eastern and Western Hemispheres. It is fairly widespread in Australia, but it does not occur in South Australia nor Victoria. The second species *P. canescens* is widely distributed in "subtropical" and "temperate" South America, but has not been recorded from Malesia or anywhere in the Pacific Islands. Within Australia, *P. canescens* is not known to occur in the Northern Territory nor in the northern halves of Western Australia, South Australia and Queensland.

Comments

Moldenke (1959, 1971, 1980) recorded *P. nodiflora* var. *reptans* (Kunth) Mold. from Northern Territory. During the present study, however, only the typical var. *nodiflora* was found in the Northern Territory. In another publication, Moldenke (1973) states that some forms in the genus *Phyla* are widely cultivated for lawns or as soil-binders.

Rye (1987) quotes "about 30 species" in the genus *Phyla*. According to present investigations, however, there are about 11 species and nearly the same number of infraspecific taxa in the genus. Rye's figure of 30 species probably comprises species and subspecific entities.

According to Raj (1983), the pollen grains in the genus *Phyla* are "brevicolpate, prolate and elliptic in equatorial view (3:2)".

Phyla species are very variable and in order to clarify the variation found in the Australian species the range of variation of the shape of leaves and bracts is shown in Figure 3.

Affinities

Phyla is closely related to *Lippia* and *Lantana* in its inflorescence being spicate or subspicate during anthesis; flowers sessile, each subtended by a sessile bract; calyx small, thin-membranous, usually hidden by the subtending bracts; perfect stamens 4; anthers without appendage; fruit composed of 2 mericarps, mostly splitting at maturity, mericarps 1-celled and 1-seeded. Nevertheless, *Phyla* may easily be distinguished by its trailing branches rooting at the nodes and with medifixed hairs. In contrast, *Lippia* and *Lantana* are shrubs or subshrubs with simple hairs. *Phyla* can also be distinguished from *Lantana* by its calyx-rim being 2 - 4-cleft or conspicuously toothed and its fruit being small, dry, with a hard and thin or papery exocarp, separating into two 1-celled mericarps. In *Lantana*, the fruit is drupaceous with a fleshy and juicy exocarp and hard endocarp. *Phyla* and *Lippia* seem to be fairly close to each other, and for a long time have been treated by some botanists as one genus. In both genera, spikes are very dense during anthesis with imbricate flowers. However, *Lippia* can easily be identified by the characters listed above. Moreover, its spikes are not usually elongating in fruit; bracts mostly ovate or lanceolate, often more or less 4-ranked and hairs not medifixed.

In general appearance, *Phyla* is more like certain species of *Verbena* than any other genus, but this superficial similarity is deceptive. *Verbena* can easily be distinguished from *Phyla* by its stems not rooting at the nodes; spikes not densely congested during anthesis; calyx usually 5-angled, 5-ribbed, unequally 5-toothed; and fruit composed of four 1-seeded mericarps.

Greene (1899) was the first to delimit the genus *Phyla* clearly along the lines as explained above. He points out that the plant "known for a century or more before Linnaeus as *Verbena nodiflora*, was retained in the *Species Plantarum* under that name". He continues to describe *Phyla's* affinities to *Lippia* and *Lantana* and delineates each of them to the detail that *Phyla* "is a small genus of more or less creeping perennial herbs" and has "a pubescence most characteristic, consisting of sessile forked [medifixed] hairs. This kind of pubescence occurs in several genera of the Cruciferae; but in the Verbenaceae it does not occur except in *Phyla*."

Key to the species

1a. Leaves non-canescent, with sharp antrorse teeth; mature spikes oblong; bracts subrhomboid to somewhat rotund; calyx lobed more than half its length; corolla usually white .... 1. *P. nodiflora*

b. Leaves canescent, with blunt short teeth or almost entire, mature spikes ovoid-globose; bracts elliptic-ovate; calyx lobed not more than half its length; corolla usually lilac or pinkish .... 2. *P. canescens*

1. **Phyla nodiflora** (L.)E. Greene, Pittonia 4 (1899) 46; var. **nodiflora.**

Dop in Lecomte (ed.), Fl. Gén. Indo-Chine 4 (1935) 780; Mold., Lilloa 4 (1939) 296, 297; Mold., Bot. Maya Area, Publ. Carnegie Inst. Wash. No. 522 (1940) 171; A.D.J. Meeuse, Blumea 5 (1942) 69; Mold. in Humbert (ed.), Fl. Madagascar (1956) 13, fig. II, 1 - 3; E. Robertson in J. Black's Fl. S. Aust. edn 2, 4 (1957) 719; Specht in Specht & Mounford, Rec. Amer. Aust. Sci. Exped. to Arnhem Land 3 (1958) 289; Mold., Résumé Verbenac. etc. (1959) 195, 197, 199, 201, 204, 206, 464; Santapau, Rec. Bot. Surv. Ind. 16, 2nd edn (1960) 188; Meikle in Hutch. & Dalz., Fl. W. Trop. Africa 2, 2nd edn (1963) 437; Backer & Bakh.f., Fl. Java 2 (1965) 597; Mold., Fifth Summary Verbenac. etc 1 & 2 (1971) 314, 325, 330, 332, 337, 341, 342, 347, 367, 898; Chippendale, Proc. Linn. Soc. New South Wales 96 (1972) 256; Mold., Ann. Missouri Bot. Gard. 60 (1973) 63; Fed., Chrom. Numb. Fl. Pl., repr. edn (1974) 216; Jafri & Ghafoor, Fl. W. Pak. No. 77 (1974) 11, fig. 2 C-E; Lopez-Pal., Fl. Venezuela, Verbenaceae (1977) 489, fig. 115; Lopez-Pal., Revista Fac. Farm. Univ. Los Andes No. 20 (1979) 30; Mold., Phytologia Mém II, Sixth Summary Verbenac. etc (1980) 286, 296, 308, 316, 321, 327, 332, 337, 340, 417, 421, 431, 452 - 454; Baines, Aust. Pl. Gen. (1981) 283; Blackall & Grieve, W. Aust. Wildfls, 2nd edn, part III B (1981) 394; G.M. Cunn. et al., Pl. West. N.S.W. (1981) 568; J. Green, Cens. Vasc. Pl. W. Aust. (1981) 89; N.G. Marchant & Perry, W. Aust. Herb. Res. Notes No. 5 (1981) 127; C.C. Towns., Fl. Turkey 7(1982)32; Beadle et al., Fl. Syd. Reg. 3rd edn (1982) 508; Mold. in Dassan. & Fosb., Fl. Ceylon 4 (1983) 236; Raj, Rev. Palaeob. Palynol. 39 (1983) 363, t. VI, 1 - 4; N. Beadle, Student Fl. N.-E. N.S.W., part 5 (1984) 850; Peekel, Fl. Bismarck Archip. (1984) 474, fig. 757; Meikle, Fl. Cyprus 2(1985)1249; Stanley in Stanley & Ross, Fl. S.E. Qld 2 (1986) 367; Dunlop, Checklist Vasc. Pl. N.T. (1987) 80; Rye in N.G. Marchant et al. (eds), Fl. Perth Region, part 1 (1987) 551; Lazarides et al., Checklist Fl. Kakadu Nat. Pk & Env. N.T. (1988) 26; H. Keng, Conc. Fl. Sing. (1990) 192; Cantino, J. Arn. Arb. 71 (1990) 334, 339, 355 & 361; Jansen et al. (eds), Pl. Resource S.E. A. (1991) 135, 241; Rye et al., Fl. Kimberley Reg. (1992) 789, fig. 241A; Verdc., Fl. Trop. E. Afr. (1992)25, fig. 4.

Type: As for *Verbena nodiflora* L.

Verbena nodiflora L., Sp. Pl. edn 1, 1 (1753) 20, **basionym**; Burm., Fl. Ind. (1768) 12, t. 6, fig. 1; Willd., Enum. Pl. Hort. Berol. (1809) 632; Roxb., Hort. Beng. (1814) 4.
Type: "*Clayton 448*, from Virginia U.S.A., undated (BM, lectotype—*fide* B. Verdcourt, 1992; isolectotypes in Herb. LINN, microfiche!). See comments.

Verbena capitata Forssk., Fl. Aegypt-Arab. (1775) 10; Blanco, Fl. Philip. edn 1 (1877) 26—*fide* Moldenke (1983).
Type: Collected on Danish Expedition to Egypt and Arabia during 1761 - 1763, *loc. incert.* (C-Herb. Forsskål microfiche!).

Blairia nodiflora (L.)Gaertn., Fruct. Sem. Pl. 1 (1788) 266, t. 56—*fide* Moldenke (1983).
Type: As for *Verbena nodiflora* L.

Phyla chinensis Lour., Fl. Cochinch. 1 (1790) 66—*fide* Moldenke (1983).
Type: Loureiro s.n., Cochinchina, loc. incert. (?BM, n.v.).

Zapania nodiflora (L.)Lam., Tabl. Encycl. Méth. Bot. 1 (1791) 59, t. 17, fig. 3; Pers., Synop. Pl. 2 (1807) 140; R. Br., Prod. Fl. Nov. Holl. (1810) 514; Sprengel, Pl. Min. Cogn. Pugill. 2 (1813) 70 - as "nudiflora".
Type: As for *Verbena nodiflora* L.

Lippia nodiflora (L.)Michaux, Fl. Bor.-Amer. 2 (1803) 15; Kunth in Humb., Bonpl. & Kunth, Nov. Gen. & Sp. Pl. 2 (1818) 264; Sprengel, Syst. Veg. 2 (1825) 751; Blume, Bijdr. Fl. Ned. Ind. (1826) 821; Wight, Ill. Ind. Bot. (1831) t. 173b, fig. 2; Walp., Repert. Bot. Syst. 4 (1845) 49; Schauer in A. DC., Prod. 11 (1847) 585; Wight, Icon. Pl. Ind. Orient. 4 (1849) 11, t. 1463; Miq., Fl. Ind. Bat. 2 (1858) 905; F. Muell., Fragm. 6 (1868) 151; Benth., Fl. Aust. 5 (1870) 35; F. Muell., Fragm. 9 (1875) 4; Syst. Cens. Aust. Pl. 1 (1882) 102; Bailey, Synop. Qld Fl. (1883) 376; C.B. Clarke in Hook.f., Fl. Br. Ind. 4 (1885) 563; Maxim., Bull. Acad. Sci. St. Petersb. sl. 31 (1887) 73; Mél. Biol. 12 (1887) 251; F. Muell., Sec. Syst. Cens. Aust. Pl. 1 (1889) 171; Bailey, Cat. Indig. & Nat. Pl. Qld (1890) 35; F.B. Forbes & Hemsley, J. Linn. Soc. 26 (1890) 251; Kuntze, Gen. Pl. 2 (1891) 508; Trimen, Handb. Fl. Ceylon 3 (1895) 347; Diels in Bot. Jahrb. 29 (1900) 547; Bailey, Qld Fl. 4 (1901) 1171; Maiden & Betche, Proc. Linn. Soc. New South Wales 31 (1906) 738; King & Gamble, J. As. Soc. Beng. 74, part 2 (1909) 797; Pulle, Nova Guinea, 8 Bot. (1910) 401; Bailey, Compr. Cat. Qld Pl. (1913) 382; Ewart & Davies, Fl. N. Terr. (1917) 236; H.J. Lam, Verbenac. Malay. Archip (1919) 16; Bull. Jard.

Bot. Buitenzorg Ser. III, 3 (1921) 5; Merr., Enum. Philip. Fl. Pl. 3 (1923) 381; Ridley, Fl. Mal. Penin. 2 (1923) 612; Britton & P. Wilson, Sci. Surv. Porto Rico & Virgin Isl. 6 (1925) 142; Merr. in Ling. Sci. J. 5 (1927) 157; Péi, Verbenac. China. Mém. Sci. Soc. China 1 (1932) 10; Junell, Symb. Bot. Upsal. 4 (1934) 31, fig. 56a - c; Duthie, Fl. Gang. Plain 2, repr. edn (1960) 84; J.F. Macbr., Fl. Peru, Field Mus. Nat. Hist. 13 (1960) 651 *p.p. excl. syn. L. canescens* Kunth, *Phyla canescens* (Kunth)E. Greene, *P. nodiflora* (L.)E. Greene var. *canescens* (Kunth)Mold. and *P. nodiflora* (L.)E. Greene var. *reptans* (Kunth)Mold.; Haines, Bot. Bihar & Orissa 2, repr. edn (1961) 740; Sastri (ed.), Wealth Ind. Vol. 6 L-M (1962) 142; Britton, Fl. Bermuda (1965) 312 & fig. 332; T. Cooke, Fl. Pres. Bombay 2, *2nd repr. edn* (1967) 499; Fed., Chrom. Numb. Fl. Pl., repr. edn (1974) 716; D. Gibson, Fl. Guatemala, Fieldiana (Bot.) 24(9), No. 1 & 2 (1970) 212; Adams, Fl. Pl. Jamaica (1972) 630; Tutin in Heywood *et al.* (eds), Fl. Europ. 3 (1972) 123; Choudhry & Roy, Cytologia 48 (1983) 732, 738, 739 & fig. 6a; Howard, Fl. Lesser Antills, part 3 (1989) 233, fig. 94 upper left.
Type: As for *Verbena nodiflora* L.

Verbena repens Bertol., Rar. Ital. Pl. Dec. 2 (1806) 27—*fide* Moldenke (1983).
Type: (?BOLO, n.v.). According to Stafleu & Cowan, [Taxonomic Literature Vol. 1: A - G (1976) 202] "Bertoloni's herbarium and types were partly destroyed, the remaining are in BOLO". No type cited with the protologue.

Platonia nodiflora (L.)Raf., Med. Repos. N.Y. 5 (1808) 352 - as "nudiflora"—*fide* Moldenke (1983).
Type: As for *Verbena nodiflora* L.

Verbena sarmentosa Willd., Enum. Hort. Berol. (1809) 632—*fide* Moldenke (1983).
Type: "Habitat in India orientali", undated (B-Willdenow Herb. no. 11122 microfiche!).

Zapania repens (Bertol.)Bertol., Rar. Ital. Pl. Dec. 3 (1810) 27—*fide* Moldenke (1983).
Type: As for *Verbena repens* Bertol.

Bertolonia crassifolia Raf., Chloris Aetn. (1815) 5—*fide* Moldenke (1983).
Type: ?P-DU, n.v.

Lippia repens (Bertol.)Sprengel, Syst. Veg. 2 (1825) 752.
Type: As for *Verbena repens* Bertol.

Lippia sarmentosa (Willd.)Sprengel, Syst. Veg. 2 (1825) 752—*fide* Moldenke (1983).
Type: As for *Verbena sarmentosa* Willd.

Zapania crassifolia (Raf.)Raf., Herb. Raf. (1833) 66—*fide* Moldenke 91983).
Type: As for *Bertolonia crassifolia* Raf.

Piarimula chinensis (Lour.)Raf., Fl. Tellur. 2 (1836) 102—*fide* Moldenke (1983).
Type: As for *Phyla chinensis* Lour.

Lippia nodiflora (L.)Michaux var. *vulgaris* Walp., Repart. Bot. Syst. 4 (1845) 49—*fide* Moldenke (1983).
Type: non cit.

Lippia nodiflora (L.)Michaux var. *repens* (Bertol.)Schauer in A. DC., Prod. 11 (1847) 586; H.J. Lam, Bull. Jard. Bot. Buitenzorg Ser. III, 3 (1921) 5—*fide* Moldenke (1983).
Type: As for *Verbena repens* Bertol.

Lippia nodiflora (L.)Michaux var. *sarmentosa* (Willd.)Schauer in A. DC., Prod. 11 (1847) 585; H.J. Lam, Bull. Jard. Bot. Buitenzorg, Ser. III, 3 (1921) 5—*fide* Moldenke (1983).
Type: As for *Verbena sarmentosa* Willd.

Lippia nodiflora (L.)Michaux var. *normalis* Kuntze, Rev. Gen. Pl. 2 (1891) 508—*fide* Moldenke (1983).
Type: "Anam: Turong. Java" (NY, n.v.).

Phyla nodiflora (L.)Greene var. *longifolia* Mold., Phytologia 2 (1941) 22; Résumé Verbenac. etc. (1959) 197, 201, 210, 464; Fifth Summary Verbenac. etc. 1 & 2 (1971) 330, 337, 347 & 899; Lopez-Pal., Revista Fac. Farm. Univ. Los Andes No. 20 (1979) 20; Mold., Ann. Missouri Bot. Gard. 60 (1973) 65; Stanley in Stanley & Ross, Fl. S.-E. Qld 2 (1986) 367 —*fide* Gibson (1970).
Type: T.G. Yuncker, J.M. Koepper & K.A. Warner (No. 8327), in sandy soil on the beach at Salado, in the vicinity of La Ceiba, Atlantida, Honduras 10.vii.1938 (NY, holotype, n.v.).

Phyla nodiflora (L.)E. Greene var. *antillana* Mold., Phytologia 40 (1978) 468—*fide* Howard (1989).
Type: N.L. Britton, E.G. Britton & J.F. Kemp (No. 83), on a hillside at Judith's Fancy, St. Croix, Virgin Island, 17 - 25.iii.1923 (NY, holotype, n.v.).

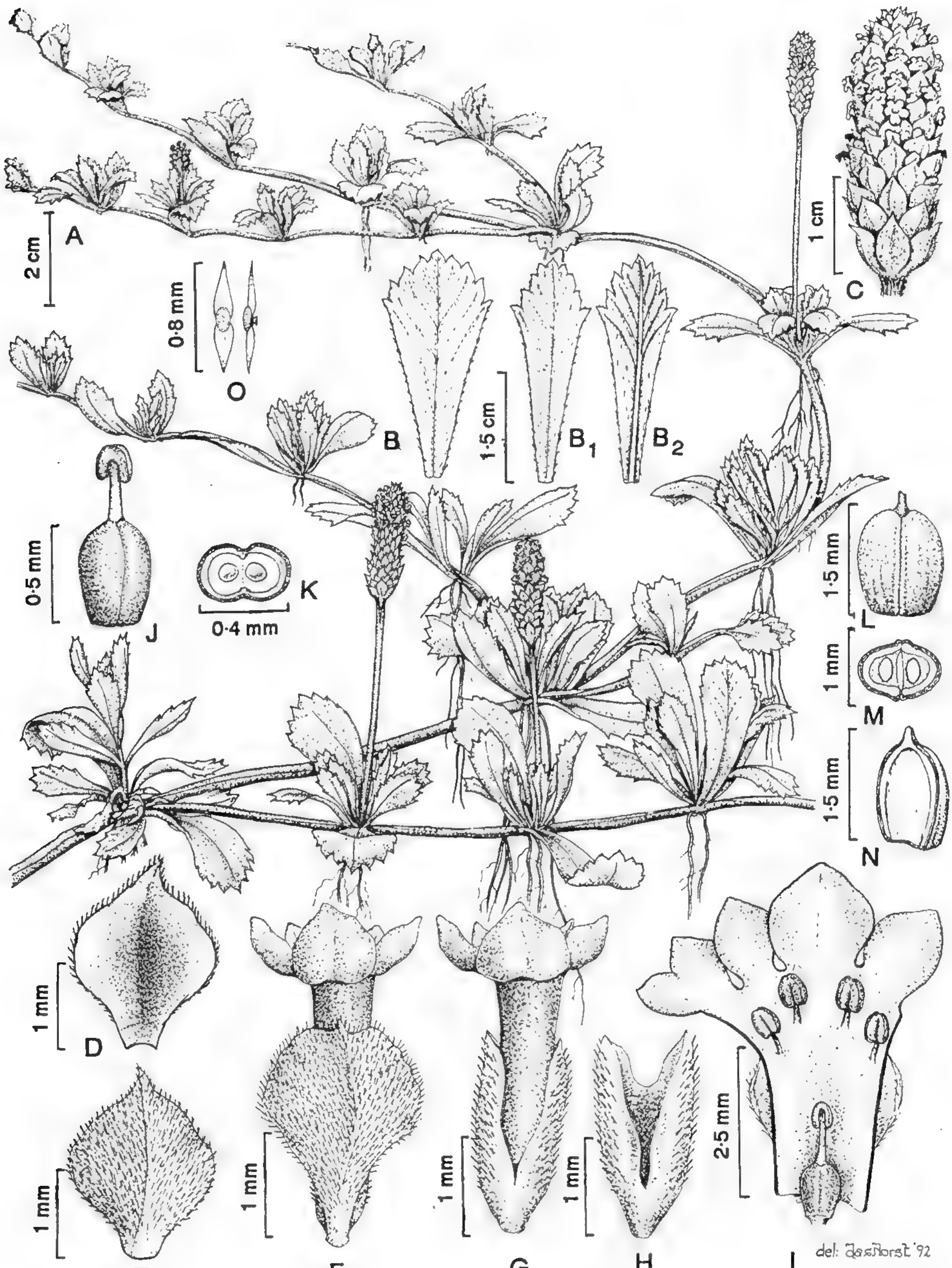


Fig. 1. *Phyla nodiflora* (L.)E. Greene var. *nodiflora* (A-O, *C.R. Dunlop 7796:* DNA). A, habit sketch of a flowering branch; B & B1, leaves showing adaxial (upper) view; B2, leaf showing abaxial (lower) view; C, cylindrical spike; D, bract showing adaxial view; E, bract showing abaxial view; F, flower with bract; G, flower with deeply lobed calyx; H, calyx lobed almost to base; I, flower longitudinally cut open showing androecium and gynoecium, and glabrous inner surface; J, ovary; K, transverse section of ovary; L, fruit; M, transverse section of fruit; N, fruitlet (mericarp); O, medifixed or malpighiaceous hairs.

Description (Fig. 1)

A prostrate creeping herb, often covered with appressed medifixed hairs. *Stem* and branches tetragonous to cylindrical, usually 30 - 95 cm long, with slender procumbent or ascending flowering branches, purplish-green, strigose or pubescent-puberulous. *Leaves* subsessile or shortly petiolate; lamina spathulate, oblanceolate or cuneate-obovate, decurrent or attenuate into the petiole, with sharp antrorse teeth in the upper half, strigose or pubescent-puberulous, (7-) 10 - 50 (-70) mm long, (2.5-) 3 - 7 (-10) mm wide. *Inforescence* solitary in leaf axils, pedunculate; spikes very dense, many-flowered, elongate-oblong or cylindrical when mature, (5-) 10 - 25 (-30) mm long, (4-) 5 - 8 (-10) mm diam.; peduncle slender, usually much longer than the subtending leaves, (30-) 40 - 100 (-110) mm long, appressed pubescent or sometimes almost glabrous. *Bracts* greenish or purplish, sessile, subequalling the corolla-tube, ovate-rotundate or subrhomboid-cuneate, truncate, mucronate, with membranous margins, 2.5 - 3 mm long, 2 - 3 (-3.5) mm wide, appressed strigose outside (abaxially), glabrous inside (adaxially). *Calyx* hyaline-membranous, flattened, slightly 2-keeled with a line of fine hairs on each keel, lobed to more than halfway or almost to the base, somewhat irregularly 4-toothed, 1.5 - 2 mm long. *Corolla* usually white or purplish-white, slightly surpassing the bracts, glabrous excepting a few hairs outside at the base of lobes, 3 - 4 (-4.5) mm long; lobes spreading, 2.5 - 3 mm across, 2-lipped, 4 - 5-lobed, the lower-lip twice as long as the upper, about half as long as the tube; tube cylindrical, glabrous, 2 - 2.5 mm long. *Stamens* included, inserted in corolla-throat; filaments short; anthers minute. *Ovary* globose, glabrous, 2-celled, 2-ovuled, 0.3 - 0.4 mm diam.; style short with capitate or subpeltate stigma, 0.3 - 0.5 mm long. *Fruit* ellipsoid-globose, glabrous, 1 - 2 mm long, 1 - 1.5 mm diam., splitting at maturity into 2 mericarps, each 1-seeded.

Representative specimens (collections seen: Australian 193, non-Australian 119)

AUSTRALIA: WESTERN AUSTRALIA: *Dunlop 7796*, Chile Head, 11.iv.1988 (BRI, DNA, NSW, PERTH); *Foulkes 19*, Roebuck Plains, SW Kimberley, 8.x.1984 (PERTH); *Gardner 3107*, Millstream Deep Reach Pool, Fortescue River, 22.viii.1932 (PERTH 2 spec.); *Keighery & Alford 1285*, Lake Coolungup, 5 km E of Safety Bay, 19.iii.1987 (PERTH); *Lullfitz L6093*, Roebuck Plain, Broome, 27.v.1968 (DNA, PERTH); *Lullfitz & Mackenzie s.n.*, 172 km N of Kununurra, 2.xi.1969 (PERTH); *Oldfield s.n.*, Murchison River, undated (MEL 583739).

NORTHERN TERRITORY: *Baker 11411*, Cobourg Peninsula, 1.viii.1964 (DNA); *Chippendale 7989*, Beatrice Hill, 64.37 km SE of Darwin, 23.iii.1961 (BRI, CANB, CBG, DNA, K, NSW); *Dunlop 2234*, Bing Bong Station, 7.vi.1971 (CANB, DNA, MEL); *Evan M3037*, Elsey Park, 5.iv.1990 (CANB, DNA, K, MEL); *Henshall 883*, Peron Island, 29.x.1974 (CANB, DNA); *Lack & McKean B303*, Humpty Doo, CSIRO Rice Farm, 25.i.1972 (CANB, DNA, K, L); *F. Mueller s.n.*, Victoria River, -.x.1955 (MEL 583741); *Munir 6101*, Annesley Point, 2.vi.1988 (AD, MEL, DNA); *Must 862*, Forestry Block, Wooner Road, 3.xi.1971 (CANB, DNA, K); *Specht 1181*, Oenpelli, 13.x.1948 (AD, BRI, CANB, K, MEL, NSW); *Telford 8362 & Wrigley s.n.*, Obiri Rock area, Kakadu National Park, 15.viii.1980 (BISH, CBG); *Thomson 2500*, Lake Eames area, 1 km E of Vanderlin Island, Sir Edward Pellow Group, 23.vii.1988 (DNA); *Waddy 630*, E coast on Groote Eylandt, 23.i.1977 (DNA); *Wightman 3177 & Smith s.n.*, Goulburn Island, Billabong area, 14.x.1986 (DNA).

QUEENSLAND: *Batianoff & McDonald 287*, 12 km N of Cattle Pt, 28 km S of Yeppoon, 15.vii.1977 (BRI); *Bick & White s.n.*, Stradbroke Island, -.iv.1916 (BRI, NSW); *Blake 15621 & Webb s.n.*, Torilla, between Broad Sound and Shoalwater Bay, 18.iv.1945 (BRI 273259). *Dietrich 184*, near Brisbane River, 1863-65 (AD, BM, BRI, CANB, NSW); *Durrington 1166*, Moreton Island, 16 km SSE of Tangalooma Point, 9.x.1973 (BRI 173227); *Forster 6477 & Reilly s.n.*, Lake Patricia, Weipa, 3.iii.1990 (BRI); *Hubbard 4461*, Fraser Island, 15.x.1930 (BRI, K); *O'Shanesy 83*, Rockhampton, 10.viii.1867 (MEL); *Paijmans 1949*, Maryborough area, upper tidal flat near mouth of Burrum River, 2.vi.1976 (CANB 2 spec.); *Thomson 860*, 10 km W of Massacre Inlet, Wentworth Station, 1.xii.1984 (AD, DNA); *Thozet s.n.*, Mouth of the Fitzroy River, undated (MEL 583726).

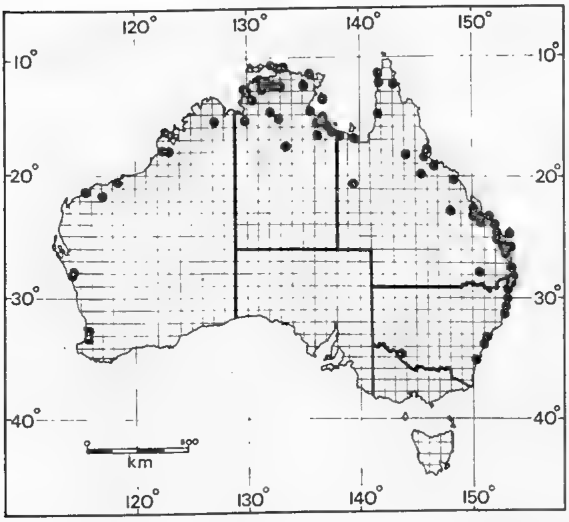
NEW SOUTH WALES: *Bäuerlen 614*, Lennox Head, -.xi.1891 (MEL, NSW); *Coveny 12454, Bishop & Murray s.n.*, Red Rock, 17.xii.1986 (CANB, MEL); *Constable s.n.*, Corindi Beach, 12.87 km N of Woolgoolga, 30.iv.1956 (K, NSW 37337); *Fairoett 238*, Ballina, Richmond River, 1877 (MEL 583744); *Forsyth s.n.*, Byron Bay, -.xi.1898 (MEL 583748, NSW 231618); *Hara s.n. & Coveny 3528*, 4.8 km W of Yamba, 21.ii.1971 (BRI, K); *Lucas 71*, Balranald, 1878 (MEL); *Stackhouse s.n.*, Clarence River, 1881 (MEL 583722).

AUSTRALIAN CAPITAL TERRITORY: *Auber s.n.*, Jervis Bay, 23.ii.1966 (CBG 015000).

PAPUA NEW GUINEA: *Henty NGF 49731*, Erap, Lae subdistrict, Morobe district, 7.xi.1974 (A, BISH, BRI, CANB, E, K, L, M, NSW, US).

COCOS (KEELING) ISLANDS: *Telford 9952 & Howard s.n.*, West Island, at settlement, 1.v.1985 (AD, CBG, K); *Williams 201 & Noor s.n.*, loc. cit. 19.v.1986 (CBG, PERTH).

Distribution and ecology (Map 2)



Map 2. Distribution of *P. nodiflora* var. *nodiflora* in Australia

According to Moldenke (1983), *P. nodiflora* var. *nodiflora* is "widely distributed throughout the subtropical and tropical portions of both the Eastern and Western Hemispheres". Cunningham et al. (1981) consider it to be an introduced and a naturalised weed in Australia. It occurs in all mainland States except South Australia and Victoria. The majority of localities in each state are in the coastal areas. A few collections, however, are known from the interior where it grows along the river banks and near lakes.

The localities in Western Australia are comparatively few and well scattered. Main distribution in this State is around Perth, Geraldton, along the North West Coastal Highway and the Great Northern Highway. The most northerly locality in the State, and the only one known in the Kimberley region, is near Wyndham.

In the Northern Territory, the distribution is mainly in the tropical northern half with the majority of localities around Darwin, in Kakadu National Park and on Cobourg Peninsula. From inland, it has been recorded from near Elliot, Bing Bong Station and along Roper River near Elsey Park. There are several localities in the coastal areas of the Gulf of Carpentaria. Its occurrence on off-shore islands of the State has been recorded from Peron Island, Croker Island, Goulburn Island, Elcho Island, Groote Eylandt, Maria Island and Sir Edward Pellow Group of Islands.

Distribution in Queensland is mainly along the east coast, particularly in the area from the New South Wales border to the Atherton Tableland. Further north, there is one locality near Temple Bay and others on the western side of Cape York Peninsula especially near Weipa, the Edward River settlement, Wentworth Station and Bentinck Island. From the interior of Queensland, it has been collected near Mt. Isa, at Junction Creek and at Peak Downs Station.

In New South Wales, it occurs in the coastal area to Sydney in the south. Within this range, the majority of localities are in the area between Port Macquarie and Tweed Heads. Further south, one locality is near Jervis Bay (A.C.T.) and another along the Murrumbidgee River near Balranald.

Collections from outside Australia have been examined from Papua New Guinea, Cocos (Keeling) Island, New Caledonia, Samoa, Indonesia, Thailand and the Philippines.

Growing in moist or wet soil of fields, lawns, hillsides, clearings, savannas, beaches, dry riverbeds, the edges of ponds and thickets. Also found in wet meadows and along irrigation ditches. Occurs from "sea level to c. 1400 m altitude".

Comments

The type of this taxon has been cited somewhat differently by various authors. In the protologue, Linnaeus (1753) cited the type: "Habitat in Virginia". In 1982, Townsend recorded the type as "a cultivated specimen (holo. BM—Hb. Cliff!)". A year later, Moldenke (1983) reported the type as "*Clayton 448* from "Virginia (LINN)". Subsequently, Meikle (1985) cited only "in Virginia". Recently, however, Verdcourt (1992) recorded the type as "U.S.A. Virginia, *Clayton 448* (BM, lecto.)". In a separate note, Verdcourt (1992) has made further comment on the type and states: "Townsend gives the type as 'a cultivated specimen (holo. BM—Hb. Cliff.!)' but Linnaeus cites 5 syntypes and gives the locality as Virginia. I have therefore accepted the specimen forming the basis of the *Gronovius* reference as lectotype". The present author has seen all Linnaeus's syntypes on microfiche and accepts Verdcourt's (1992) selection of the lectotype for this species.

According to Moldenke (1940a), *P. nodiflora* var. *nodiflora* is "especially pernicious in moist sandy soil. As is to be expected in the case of a species with such a wide distribution and weedy habit, it is extremely variable and polymorphic. A number of forms have been segregated and named, and, indeed, many specimens, representing the extremes in variation, certainly give every indication of being worthy of nomenclatural segregation. Examination of a large series of specimens, however, shows that these forms overlap and intergrade so completely, even in the same locality and often on the same plant, that it hardly seems desirable to give them nomenclatural recognition". The above comments are equally applicable to the Australian collections of this variety (see Fig. 2 for range of variation in shape of leaves). Thus, the var. *longifolia* recorded from Australia by Moldenke (1959, 1971, 1973, 1980) and Stanley (1986) does not seem to be a distinct variety. The characters used to distinguish it from the typical variety overlap and intergrade so completely in the range of Australian specimens examined, that it is not possible to draw a definite line between the two taxa. The var. *longifolia* seems to be a somewhat long-leaved form of the typical variety. Therefore, following Gibson (1970), it has been placed in the synonymy of the latter.

Moldenke (1959, 1971, 1980) also reported var. *reptans* (Sprengel)Mold. from the Northern Territory in Australia. In a later publication by Moldenke (1983), he distinguished this variety from the typical form by its leaves being "much larger in size, often 3 - 4.5 cm long and 1.5 - 2.5 cm wide, the teeth often more spreading, and the larger venation (midrib and secondaries) quite firm, distinct, and prominulous on the lower surface". In a few other publications e.g. Britton & P. Wilson (1925), D. Gibson (1970) and Moldenke (1939, 1940), this taxon has been distinguished chiefly by its leaf-blades being thin-textured, venation quite prominent beneath and impressed above. During present investigation, a range of collections from the Northern Territory has been examined and no specimen with uniformly large-sized leaves and distinctly prominent venation beneath has been found. Neither has any such specimen been found in any other Australian collection of this species. Therefore, the existence of var. *reptans* in Australia has not been confirmed.

According to Bentham (1870), *P. nodiflora* is "the commonest species of all" those known in this genus. In his view, "it is very variable in the breadth of the leaves, the size of the spikes and flowers, the points and teeth of the bracts, &c."

In view of the large number of synonyms included under this species, E. Greene (1899) comments that "if all that passes under this name is one species, it certainly has a most remarkable geographic range, being found in the tropical and subtropical parts of all the continents and of every archipelago that lies within those lines. It is curious that Linnaeus names only "Virginia" as the habitat of the species, while it had been known as thoroughly indigenous to the Mediterranean region of the Old World for at least a hundred years before his day".

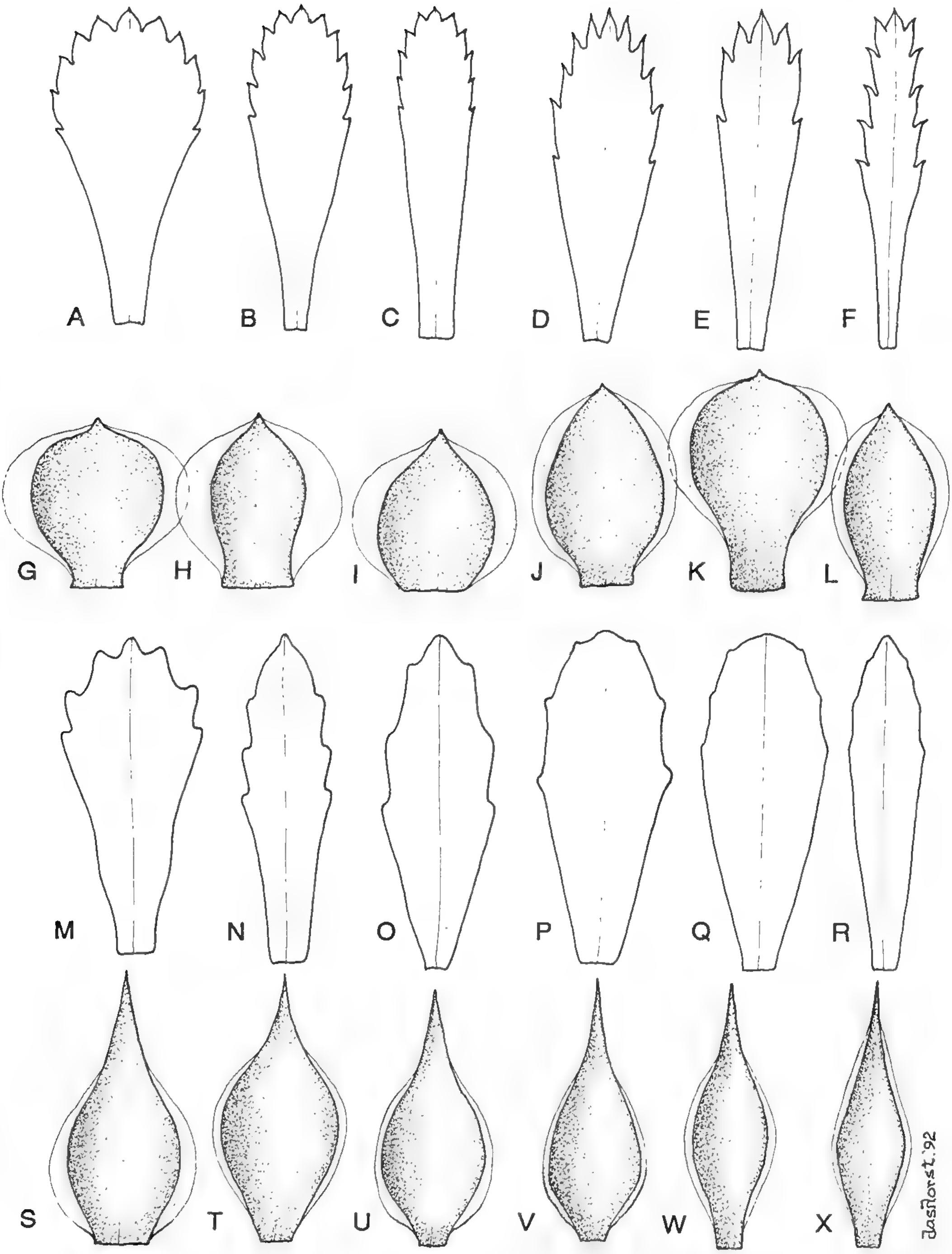


Fig. 2. Range of variation in shape of leaves (A-F, M-R) and bracts (G-L, S-X) of *Phyla nodiflora* (L.)E. Greene var. *nodiflora* (A-L) and *Phyla canescens* (Kunth)E. Greene (M-X). (A, *R.L. Specht 1181*: MEL; B, N. *Byrnes 1082 & J.R. Maconochie s.n.*: AD; C, *W.A. Cusack 213*: MEL; D, *G.J. Keighery 3907*: PERTH; E, *C.R. Dunlop 7796*: DNA; F, *C.R. Dunlop 2234*: DNA; G, *R. Collins BC182*: CBG; H, *C.R. Dunlop 2234*: DNA; I, *M. Evans 3037*: DNA; J, *M. Lazarides 8730*: CANB; K, *D. Bowman 85*: DNA; L, *L. Durrington 3*: BRI; M, *Hj. Eichler 17159*: AD; N, *M.D. Crisp 6990*: CBG; O, *R. Bates 6787*: AD; P, *A.W. Bell 97*: AD; Q, *D.E. Symon 12970*: AD; R. *H.I. Aston 2728*: MEL; S, *Hj. Eichler 17159*: AD; T, *P.M. Kloot s.n.*: CANB 352037; U, *H.I. Aston 2728*: MEL; V, *A.C. Beauglehole 55713*: MEL; W, *J. Henshall s.n.*: MEL; X, *H. Dillewaard 384 & M. Olsen s.n.*: CANB).

All *Phyla* collections from South Australia and Victoria are found to belong to the second species, *P. canescens*. *P. nodiflora* was probably introduced into Australia during the last century and has now become naturalised in most mainland states.

Among its many vernacular names in various parts of the world, some popular ones are: "Fog-fruit", "Cape-weed", "Godet's-weed", "Link-weed", "Lippia-grass", "Mat-grass", "Spanish-bush" and "Cidron". In Australia, the common names used for this species are: "Lippia", "Fog-fruit", "Phyla", "Carpet-weed", "Mat-grass" or "No mow grass".

Affinities

Within the species, *P. nodiflora* var. *nodiflora* is closely related to var. *reptans* (Kunth)Mold. in its stem being herbaceous and trailing, rooting at nodes; leaf-blades cuneate-ovate, spathulate, or narrowly oblanceolate, usually dentate only from the widest part to the apex; peduncles much longer than the flower-spikes. According to Moldenke (1940a, 1983), however, var. *reptans* "differs from the typical form of the species, in being usually more densely strigose throughout and in having the leaves thinner in texture, often rhomboid, broadly rhomboid-elliptic, or even rhomboid-ovate, with the teeth usually more salient and the larger venation (midrib and secondaries) firmer, more or less impressed above and conspicuously prominulous or prominent beneath". Both varieties occur in almost similar habitat. In distribution, var. *reptans* is considered by Moldenke (1940a) as occurring "practically throughout the range of the species". As mentioned before under "Comments", the presence of var. *reptans* in Australia has not been confirmed.

Var. *nodiflora* seems fairly close to *P. canescens* in its habit, shape of leaves and size of peduncles. Nevertheless, *P. canescens* may easily be distinguished by its stem and leaves being greyish or canescent, leaves with blunt short teeth or almost entire, mature spikes ovoid-globose, bracts elliptic-ovate or elliptic-lanceolate, calyx lobed to not more than halfway and corolla usually lilac or somewhat pinkish.

2. **Phyla canescens** (Kunth)E. Greene, Pittonia 4 (1899) 48; C.C. Towns., Fl. Turkey 7(1982)32.
Type: As for *Lippia canescens* Kunth.

Lippia canescens Kunth in Humb., Bonpl. & Kunth, Nov. Gen. & Sp. Pl. 2 (1818) 263, **basionym**; Sprengel, Syst. Veg. 2 (1825) 751; Cham. in Linn. 7 (1832) 213; Walp., Repert. Bot. Syst. 4 (1845) 48; Sevenson, Amer. J. Bot. 33 (1946) 480; Schauer in A. DC., Prod. 11 (1847) 585; J. Black, Fl. S. Aust. edn 1 (1929) 698; Mold., Fifth Summary Verbenac. etc. 2 (1971) 552, prosyn.; Tutin in Tutin, Heywood et al. (eds), Fl. Europ. 3 (1972) 123.
Type: Humboldt s.n., "Crescit in litore Oceoni pacifici juxta urbem Truxillo: item Lamam inter et portum callao," Peru, undated (P, isotype!).

Phyla nodiflora (L.)E. Greene var. *canescens* (Kunth)Mold., Phytologia 1 (1934) 98; Mold., Verbenac. & Avicen. Trinidad & Tobago, Lilloa 4 (1939) 297; Mold., Résumé Verbenac. etc. (1959) 157, 221, 311, 315, 334, 393, 394, 464; Fifth Summary Verbenac. etc. 1 & 2 (1971) 277, 367, 552, 561, 600, 601, 667, 899; Phytologia Mem. II, Sixth Summary Verbenac. etc. (1980) 358, 415, 419, 431; Webb et al., Fl. New Zealand 4 (1988) 1275, fig. 121C; J.H. Ross (ed.), Cens. Vasc. Pl. Vic. edn 4(1993)181.
Type: As for *Lippia canescens* Kunth.

Phyla nodiflora auct. non (L.)E. Greene: sensu L. Bailey, Man. Cult. Pl. (1949) 842, *p.p. quoad syn. Lippia canescens* Kunth & *Phyla nodiflora* (L.)Greene var. *canescens* (Kunth)Mold.; J.H. Willis, Handb. Pl. Vic. 2 (1972) 579; Munir in Jessop & Toelken (eds), Fl. S. Aust. part 3 (1986) 1175, fig. 544B; Munir in Jessop (ed.), List Vasc. Pl. S. Aust. edn III (1989) 87; Cooke, S. Aust. Naturalist 65 (1991) 65, *quoad spec. M. Zwarts 56*, from Head of Gilbert, S.A., 8.ii.1990 (ADA 10798).

Lippia nodiflora (L.)Michaux f. *canescens* (Kunth)Kuntze, Gen. Pl. 2 (1891) 508.
Type: As for *Lippia canescens* Kunth.

Lippia nodiflora auct. non (L.)Michaux: Ewart, Fl. Vic. (1930) 974; J.F. Macbr., Fl. Peru, Field Museum Nat. Hist. 13 (1960) 651, *p.p. quoad syn. Lippia canescens* Kunth, *Phyla canescens* (Kunth)E. Greene and *Phyla nodiflora* (L.)Greene var. *canescens* (Kunth)Mold.

Phyla nodiflora (L.)E. Greene var. *rosea* (D. Don)Mold., Résumé Verbenae etc. (1959) 465.
Type: As for *Zapania nodiflora* (L.)Lam. var. *rosea* D. Don

Zapania canescens (Kunth)Gibert, Enum. Pl. Montev. (1873) 44.
Type: As for *Lippia canescens* Kunth.

Zapania nodiflora (L.)Lam. var. *rosea* D. Don in Sweet, Brit. Fl. Gard. Ser. 2, 3 (1834) t. 225.
Type: Mr. Knight's s.n. collection, originally introduced from Chile, by Mr. Hugh Cuming (LINN). Plate 225 in Sweet, Brit. Fl. Gard. Ser. 2, 3: 1934, derived from *Mr. Knight's s.n. coll.*!

Lippia nodiflora (L.)Michaux var. *rosea* (D. Don)J.F. Macbr., Fl. Peru, Field Museum Nat. Hist. 13 (1960) 651.
Type: As for *Zapania nodiflora* (L.)Lam. var. *rosea* D. Don.

Lippia nodiflora var. *sarmentosa* auct. non (Willd.)Schauer: Ewart, Fl. Vic. (1930) 974.

Lippia nodiflora var. *repens* auct. non (Bertol.)Schauer: Ewart, Fl. Vic. (1930) 974.

Description (Fig. 3)

Perennial herb with procumbent or ascending flowering branches, more or less conspicuously hoary (canescent) throughout with medifixed hairs. *Stem* branched, almost cylindrical or obtusely tetragonal, somewhat woody at base, rooting at the nodes. *Leaves* subsessile or shortly petiolate, obovate to oblanceolate, with a long-cuneate base, (5-) 10 - 20 (-30) mm long, (2-) 3 - 7 (-10) mm wide, entire or bluntly toothed above the middle, rounded or subobtuse at the apex, more or less canescent; petiole 2 - 5 mm long. *Spikes* ovoid to oblong-ovoid, (3-) 5 - 8 (-10) mm diam.; peduncles slender, usually much longer than the subtending leaves, canescent-pubescent or almost glabrous, (10-) 15 - 45 (-65) mm long. *Bracts* ovate, elliptic-ovate or elliptic-lanceolate, entire, more or less long acuminate, with a very narrow membranous margin, (1.5-) 2 - 3 mm long, 1 - 2 mm wide, appressed canescent-pubescent outside (abaxially), glabrous inside (adaxially). *Calyx* lobed to not more than halfway, 1.5 - 2.5 mm long, canescent outside, glabrous inside. *Corolla* mauve, lilac or whitish-pink, 3 - 4 mm long, glabrous outside excepting a narrow band of short hairs at the base of lobes, glabrous inside; lobes unequal, 2-lipped, spreading to 3 mm across; tube 2 - 3 mm long. *Stamens* inserted about the middle of the corolla-tube. *Ovary* globose, glabrous, ± 0.5 mm diam.; style short, ± 0.5 mm long, glabrous, with ± capitate stigma. *Fruit* ellipsoid-globose, glabrous, 1 - 1.5 mm diam.

Representative specimens (collections seen: Australian 92, non-Australian 25)

AUSTRALIA: WESTERN AUSTRALIA: *Gardner 9545*, Mount Charlotte Reservoir, Kalgoorlie, -.xi.1949 (PERTH); *Hocking s.n.*, Tammin, 2.v.1953 (PERTH 2 spec.); *Reynolds s.n.*, Northam, -.iv.1964 (PERTH).

SOUTH AUSTRALIA: *Bell 97*, between Maclaren Flat and Blewitt Springs, Noarlunga, 23.xii.1976 (AD 2 spec., ZT); *Copley 931*, northern end of Bute main street, N. Yorke Peninsula, 4.xii.1966 (AD, MEL); *Eichler 17159*, roadside in Fullarton, Nelson Street, 28.i.1963 (AD); *Ising s.n.*, Banks of Torrens Lake, 24.i.1927 (AD); *Southcott s.n.*, S.E. corner of Parklands, Adelaide, 1.i.1960 (AD, COLO, CAI, CAL, CANB, CHR, E, F); *Symon 3900*, N.E. of Clare, 16.xii.1965 (AD, CANB, DAV, SPN); *Symon 13087*, N. of Berri on outskirts of township, Upper River Murray, 20.i.1983 (AD 2 spec., CANB, K, L. MO, US); *Symon 13775*, Fleurieu Peninsula, roadside on Chaffey's Road at Chapel Vale Winery, 25.i.1984 (AAU, AD 2 spec., BH, CANB, K); *Womersley 433 & Symon s.n.*, 1.5 km W of Nelwood Homestead, Murray region, 11.ix.1979 (AD); *Zwarts 56*, Head of Gilbert River, 8.ii.1990 (ADA).

QUEENSLAND: *Dillewaard 384 & Olsen s.n.*, 5 km SW of Brookstead, 5.ii.1981 (BRI, CANB, K); *Filet s.n.*, Toogoolawah, 24.vii.1964 (BRI 058465); *Kleinschmidt s.n.*, Cecil Plains, north branch Condamine, -.xii.1968 (BRI 087805); *Pedley 372*, 5.8 km W of Westmar, 15.i.1959 (BRI, CANB); *Roberts & Craig s.n.*, Toobeah, 26.v.1961 (BRI 028161); *Stevens s.n.*, Kianga, Dawson Valley, 6.iii.1965 (BRI 057775); *White 12582*, Darling Downs, Tummaville, 19.i.1944 (BRI 268481).

NEW SOUTH WALES: *Cunningham & Milthorpe 4622*, Darling River, Anabranch on Wentworth - Renmark road, 27.iv.1976 (NSW); *Leigh 5346*, Lake Edge, c. 40 km S.W. of Deniliquin, 18.xii.1964 (NSW); *Michael & Gray s.n.*, Flemington Saleyards, Sydney, 23.x.1969 (CANB 332085, NSW 231620); *Paijmans 3950*, Macquarie Marshes, bank of northern by-pass Channel, 35 km NW of Quambone, 16.xii.1980 (CANB); *Semple 1070*, Moola, 3.21 km N. of Balranald, 13.i.1981 (NSW 231762); *Waite 1813*, Wentworth, 13.ii.1955 (NSW); *Wilson 874*, Talmoi Lagoon, c. 48 km NW of Moree, 27.xii.1974 (NSW); *Wilson 5684*, Lachlan River, 8 km W. of Jemalong Weir on Condobolin road, 29.xi.1983 (K, MO, NSW).

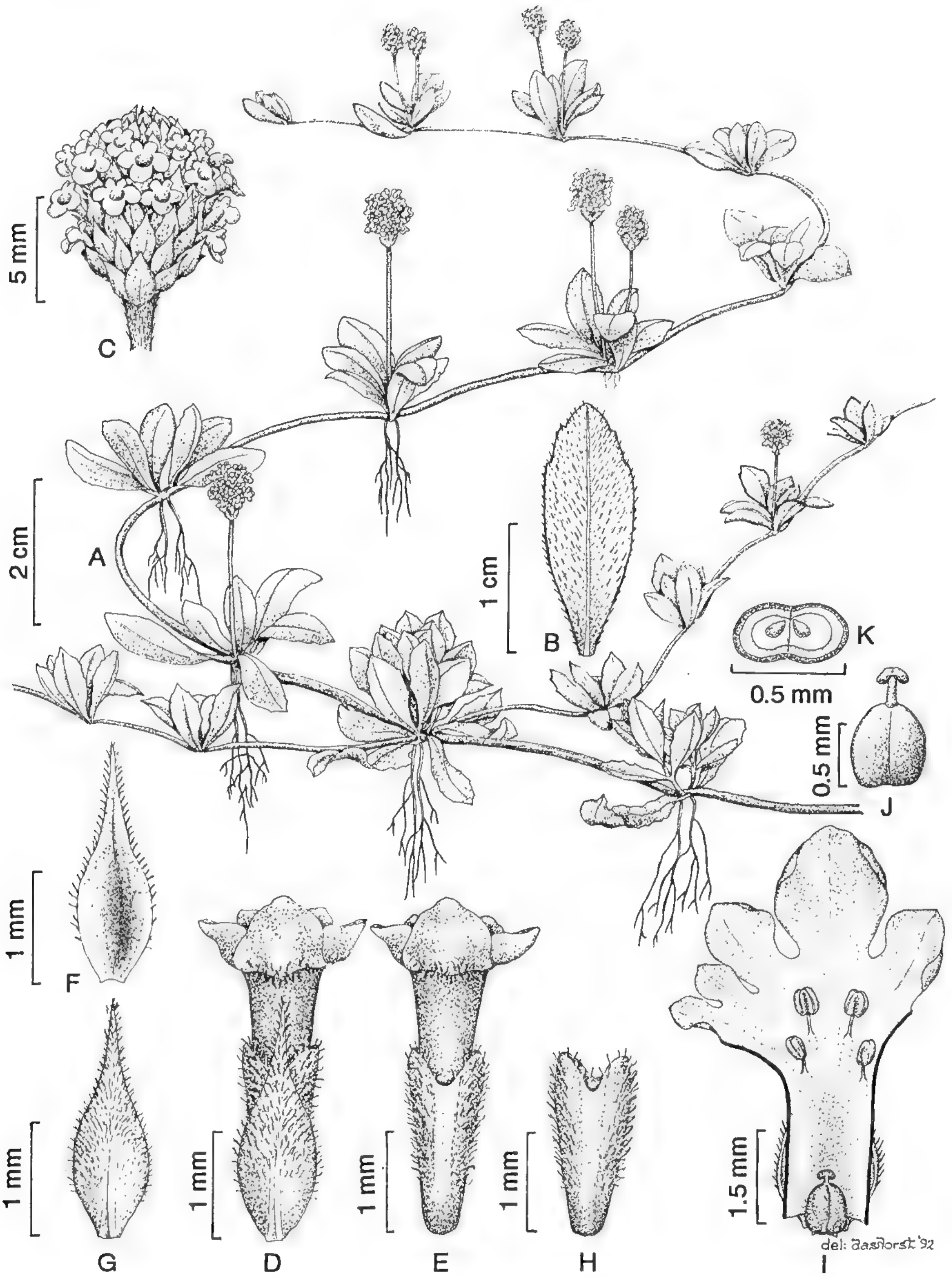
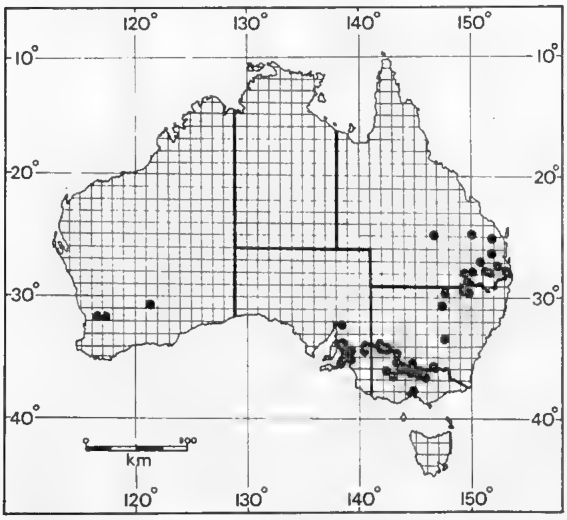


Fig. 3. *Phyla canescens* (Kunth)E. Greene (A-K, *D.E. Symon 12970*: AD). A, habit sketch of a flowering branch; B, leaf with almost entire margin; C, globose spike; D, flower with bract; E, flower without bract; F, bract showing adaxial (inside) view; G, bract showing abaxial (outside) view; H, calyx with short lobes; I, flower longitudinally cut open showing androecium and gynoecium, and glabrous inside; J, ovary; K, transverse section of ovary.

VICTORIA: *Aston 2728*, E. of Vinifera, c. 1 km E. of where the road from Vinifera to Woorinen South joins the Murray Valley Highway, 16.xii.1988 (BRI, MEL, RSA); *Beauglehole 33428 & Henshall s.n.*, c. 1 km upstream from Red Cliffs Pumping Station on Murray River, 27.iii.1970 (MEL); *Beauglehole 55713*, c. 7.5 km N.N.W. of Kerang, 26.iv.1977 (CANB, MEL); *Beauglehole 76501*, Mullinger Swamp Wildlife Reserve, 13.iii.1984 (MEL); *Beauglehole 84890*, Warracknabeal Roadside Reserve, 7.x.1986 (MEL); *Chesterfield 2552*, Junction of Goulburn River and Murray River, 23.xi.1988 (CANB, MEL); *Jensen 118*, railway track, S. Kensington, Melbourne, 8.xii.1977 (MEL 1502258); *Macfarlane 1466*, adjacent to Piambie State Forest, 31.xii.1982 (LTB, MEL); *Smith 67/65*, near N.W. of Birchip, 10.iii.1967 (AD, MEL).

Distribution and ecology (Map 3)



Map 3. Distribution of *P. canescens* in Australia

Outside Australia, *P. canescens* has been recorded by Moldenke (1959, 1971, 1980) from the U.S.A., Mexico, Ecuador, Peru, Paraguay, Chile, Argentina, Egypt, Ethiopia, Mascarene Islands (Mauritius), and southern India. So far, it has not been recorded from Malesia or any Island in the Pacific Ocean.

In Australia, *P. canescens* is known to occur in Western Australia, South Australia, Victoria, New South Wales and Queensland. Distribution in Western Australia is known only along the Great Eastern Highway near Northam, Tammin and Mt. Charlotte north of Kalgoorlie. In South Australia, the occurrence is chiefly in the Northern and Southern Lofty regions, and along the banks of the Murray River near Loxton and Renmark.

It has been collected frequently along both sides of the Murray River in Victoria and New South Wales. A few inland Victorian localities are near Warracknabeal, St Arnaud, Lake Boort Reserve, Shepparton and near the junction of the Goulburn and Murray Rivers. The southern-most record in that state is on the Yarra River near Melbourne. In the north of New South Wales it has been recorded from N.W. of Moree near Broadwater Creek, Angedool, Talmoi Lagoon and Gingham Channel. Further inland, one locality is to the N.W. of Quambone in Macquarie River Marshes and other along the Lachlan River near Condobolin township. It has also been reported from the suburb of Flemington near Sydney.

In Queensland, it is known chiefly in the south-eastern corner of the state where all known localities except one are found between 24° and 29°S and between 149° and 154°E. Within this limit, most localities are along the Dawson River, Condamine River, Weir River and their tributaries. The locality outside the above limit is near Mount Playfair between Tambo and Springsure.

According to collectors' field notes, it is a prostrate matted herb growing chiefly on flood plains in heavy clay soil. It is also known from swamps and along the banks of rivers, near lakes and in moist-wet areas around water-holes. It is known to grow commonly in *Eucalyptus camaldulensis* forest on heavy grey clay soil.

Comments

The occurrence of *P. canescens* in Australia is recorded here for the first time. Within Australia, specimens have been previously identified as *Lippia nodiflora*, *Lippia nodiflora* var. *repens* and *Phyla nodiflora*. Lately, however, several collections of this taxon are found annotated as *Phyla nodiflora* var. *canescens*. This varietal name, however, has never been recorded in any Australian publication. It is worth noting that *P. canescens* is the only *Phyla* species known to occur in South Australia and Victoria. Otherwise, this species has been recorded from all mainland states except Northern Territory. So far, it has not been reported from Tasmania.

According to collectors' field notes, this taxon is considered to be spreading rapidly and could be a menace in cultivated areas. In the opinion of one collector (*E. Jurgs s.n.*: BRI 015723), there is a fear of its becoming a pest and "can be killed by spraying with 2, 4-D weed killer". The plant seems to be drought resistant and could perhaps become a serious weed if not controlled at an initial stage. Another collector (*C. Waugh s.n.* BRI 268479) states: "it shows promise as a lawn grass, being evergreen, low growing, close matted and easily mown. Wherever it grows, all grasses and weeds are completely smothered by it and nothing appearing through it. It seems to be a very destructive weed with strong underground stems".

D. Don (1834) described it as "forming a compact patch, which, when in flower, has a very pretty effect, being then adorned with innumerable heads of pink blossoms, marked with a yellow spot. It is nearly, if not quite, hardy; and is highly ornamental, whether kept in pots, or planted in a rock-work. A mixture of sandy peat and loam will be found to suit it well; and it is easily increased by slips, for almost every branch is supplied with roots." According to Moldenke (1959, 1971, 1980) it has been under cultivation in the U.S.A., France and England.

In Flora Europaea, Tutin (1972) described its corolla as "densely pubescent without". During present investigation, however, the corolla is found to be glabrous all over excepting a narrow hairy band outside at the base of lobes only.

It has been known by various common names viz: "carpet weed", "grey fog-fruit" or "pink-flowered knotted Zappania".

Affinity

P. canescens is closely related to *P. nodiflora* and has been often treated as a synonym or a variety of *P. nodiflora*. For similarities and differences between these two species see "Key to the species" and "affinity" under *P. nodiflora*.

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A TAXONOMIC REVISION OF THE GENUS *LIPPIA* [HOUST. EX] LINN. (VERBENACEAE)* IN AUSTRALIA

Ahmad Abid Munir

State Herbarium, Botanic Gardens, North Terrace, Adelaide, South Australia 5000

Abstract

A taxonomic revision of the genus *Lippia* in Australia is presented. Only one species is recorded from Australia, identified for the first time as *L. alba*. Affinities and distribution are considered for the genus and the species. A detailed description of the species is supplemented by a habit sketch of a flowering branch and analytical drawings of the flower as well as leaf variation.

Taxonomic History of the Genus

Linnaeus (1753) established the genus *Lippia* with one species, *L. americana*, the type of which came from Veracruz, Mexico. It was placed in the group "Didynamia Angiospermia" where it was retained by Reichard (1778), Murray (1784), Gmelin (1792), Persoon (1797, 1807), Willdenow (1800), Michaux (1803), Link (1822), Poiret (1823), Sprengel (1825), Sweet (1827), Loudon (1830), Dietrich (1842) and others. Adanson (1763) placed it in "Premiere Section" of "Verbenae", Gleditsch (1764) in "Petalostemonum", Rüling (1774) in "Jasmina" and Scopoli (1777) in "Caprifolia". Subsequently, Scopoli (1786) described from north-west Italy the genus *Zappania*, which the present author has placed in the synonymy of *Lippia*. Gaertner (1788) recorded *Lippia* in "Centuria Quarta", de Jussieu (1789) in "Vitices", Necker (1790) in his "Plasyrgophyta", Poiret (1791) in "Diandria Monogynia", Schreber (1791) in "Didynamia Gymnospermia", Batsch (1802) in "Personatar" and Reichenbach (1828) under the tribe "Verbeneae" in the Labiatae. In 1805, Jaume Saint-Hilaire proposed the family Verbenaceae for *Lippia* and other related genera. The family Verbenaceae was accepted for the genus by de Jussieu (1806), Robert Brown (1810), Kunth (1818), Blume (1926), Endlicher (1838), Bentham (1839, 1870, 1876), Lindley (1847), Schauer (1847), F. Mueller (1868, 1882, 1889), Briquet (1895), Bailey (1883, 1890, 1901, 1913), H.J. Lam (1919) and by the majority of other botanists.

In 1829, Dumortier divided the Verbenaceae into two tribes: Verbeneae and Viticeae, with *Lippia* in the tribe Verbeneae. This tribe was accepted for the genus by Bartling (1830), Bentham (1839, 1870, 1876), Spach (1840), Brongniart (1843), Schauer (1847), Walpers (1852), Miquel (1858), Grisebach (1862), Harvey (1868), Bailey (1883, 1890, 1901, 1913), Caruel (1884), C.B. Clarke (1885), Gray (1886), Durand (1888), Post & Kuntze (1904), King & Gamble (1909), Lemée (1943) and others. Endlicher (1838) divided the family Verbenaceae into three tribes: Lippieae, Lantaneae and Aegiphileae, with *Lippia* in the tribe Lippieae. This tribe was accepted for the genus by Meisner (1840), Dietrich (1842) and Walpers (1845, 1847). Schauer (1847) re-classified the Verbenaceae into three tribes: Verbeneae, Viteae and Avicennieae. He based the tribe Verbeneae on its inflorescence being indeterminate, ovule erect, anatropous, attached at the base of the locule; Viteae on inflorescence definite, ovules pendulous, amphitropous or subanatropous, attached to the central axis, and Avicennieae on inflorescence capitate, ovules paired, pendulous, amphitropous, attached to the apex of the axis. Schauer (1847) subdivided the tribe Verbeneae into seven subtribes: Spielmannieae, Monochileae, Casselieae, Verbeneae, Lantaneae, Duranteae and Petreeae, with *Lippia* in the subtribe Verbeneae. He also divided the genus into five sections: *Aloysia*, *Goniostachyum*,

* The present treatment of the genus *Lippia* is the thirteenth in the series of taxonomic revisions in the family Verbenaceae in Australia. (See Munir, 1982, 1984a, 1984b, 1985, 1987a, 1987b, 1989, 1990a, 1990b, 1991, 1992, 1993a.)

Dipterocalyx, Zapania and *Rhodolippia*, with Australian species of the genus in the section *Zapania.*

Bentham (1876) proposed a new classification for the Verbenaceae by dividing it into eight tribes: Phrymeae, Stilbeae, Chloantheae, Verbeneae, Viticeae, Caryopterideae, Symphoremeae and Avicennieae, with *Lippia* in the tribe Verbeneae. He too divided the genus into two sections: *Aloysia* and *Zapania*, with Australian species of the genus in the section Zapania. In 1895, Briquet re-classified the Verbenaceae and upgraded the tribe Verbeneae to a subfamily Verbenoideae. The latter consisted of six tribes: Euverbeneae, Lantaneae, Priveae, Monochileae, Petraeeae and Citharexyleae, with *Lippia* in the tribe Lantaneae. This classification was adopted by Dalla Torre & Harms (1904), H.J. Lam (1919), Junell (1934), Moldenke (1959, 1971), Melchior (1964), Lopez-Polacios (1977), Raj and several others. In the same treatment, Briquet (1895) subdivided the genus *Lippia* into two subgenera: *Aloysia* and *Zapania.* He further subdivided the subgenus *Zapania* into five groups "*Gonostachym*" [*Goniostachyum* Schauer], *Acantholippia, Dipterocalyx, Euzapania* and *Rhodolippia.* The group *Euzapania* was further subdivided into three subgroups: *Axilliflorae, Paniculatae* and *Corymbosae*, with Australian species apparently in the subgroup *Axilliflorae.* These subgenera, groups and subgroups were adopted by Dalla Torre & Harms (1904). The majority of botanists, however, have not divided the genus into subgenera and groups, but have retained it in the Verbenaceae without reference to any subfamily or a tribe. In the present work, Briquet's (1895) classification of the Verbenaceae is followed in retaining *Lippia* in the tribe Lantaneae. The subgenera, groups and subgroups proposed for the genus, however, are not accepted because of the unreliability of characters used.

Australian History of the Genus

The first Australian specimens of *Lippia* as circumscribed here (excluding *Phyla* Lour. and *Aloysia* Ort.) were collected by John Dallachy during 1863, from Rockhampton, Queensland. Then more specimens were collected from the same area by O'Shanesy during 1864-1865, Dietrich during 1865 and Thozet during 1863-1865. Subsequently at least one collection was made by F.M. Bailey along the Fitzroy River in the town of Rockhampton. Recently a few more collections were made on Cape York Peninsula and west of Rockhampton. In 1969, the first and the only known collection of *Lippia* from Northern Territory was made by N. Byrnes from south of Darwin between Daly Waters and Larrima.

The first written record of this genus in Australia was published by F. Mueller (1868) when he described O'Shanesy's and Thozet's collections [two of each] from Queensland as a new *Lippia* species *L. lantanifolia.* Later, Bentham (1870) recognised one of Dallachy's collections from Rockhampton as *L. geminata* Kunth. Subsequently, F. Mueller (1882, 1889), Bailey (1883, 1890, 1901, 1913), Ewart & Davies (1917), H.J. Lam (1919) although recording this genus from Australia, included *Phyla* Lour. in *Lippia* (s.lat.). The former has been accepted now as a distinct genus. None of these authors, however, recorded *L. lantanifolia* as a synonym of *L. geminata.* Moldenke (1959, 1971, 1978, 1980) recorded both names as distinct species with *L. lantanifolia* as "endemic to Queensland", Australia. In most floras, *L. geminata* has been recorded as distinct or lately as a synonym of *L. alba* (Mill.)N.E. Br. ex Britton & P. Wilson. None of these floras, however, has ever shown *L. lantanifolia* in the synonymy of the above named species. During the present study, therefore, *L. lantanifolia* is recorded here as a *syn. nov.* of *L. alba.*

The recent records of *Lippia* (s.str.) from Australia were emumerated by Moldenke (1959, 1971, 1980, 1981), Burbidge (1963), Baines (1981), Munir (1983), Chapman (1991) and Leach et al. (1992). Introduced and naturalised in the tropics of Australia, it has not yet spread beyond Northern Territory and Queensland boundaries. Presently only one species of *Lippia* is known in Australia.

Chromosome numbers

Chromosome counts of only three *Lippia* (s.str.) species are available. The majority are reported from *L. alba*. These counts are based on material from outside Australia. The highest number (2n = 40 (42?)) was reported by Moldenke (1973) and the lowest (2n = 24) by Coleman (1982). The earliest chromosome count (2n = 30) was reported by Choudhury & Bose (1956) from *L. geminata* Kunth. This was later reconfirmed and/or recorded by Bose & Choudhury (1960) and Fedorov (1974). Of the same species, the haploid number 16 was recorded by Kumar & Dutt (1989). In 1982, Coleman reported a haploid number of 12 from *L. salviaefolia* Cham. and Filippa (1984) recorded a haploid number of 15 from *L. turbinata* Griseb. The chromosome number 2n = 30 seems to be generally consistent in the genus *Lippia* (s.str.).

LIPPIA [Houst. ex] Linn.

Lippia [Houst. ex] Linn., Sp. Pl. 2 (1753) 633; Gen. Pl. edn 5 (1754) 282; Adans., Fam. Pl. 2 (1763) 198; Reichard, Gen. Pl. (1774) 324, n. 844; Scop., Intr. Hist. Nat. (1777) 146; Juss., Gen. Pl. (1789) 109; Poir. in Lam., Encycl. Meth. Bot. 3 (1789) 531; Poir. in Lam., Tabl. Encycl. Meth. Bot. 1 (1791) 56; J.F. Gmel., Linn. Syst. Nat. 2 (1792) 955; Willd., Linn. Sp. Pl. edn 4, 3 (1800) 356; J. St.-Hil., Expos. Fam. Nat. 1 (1805) 250; Juss., Ann. Mus. Hist. Nat. 7 (1806) 75; Kunth in Humb., Bonpl. & Kunth, Nov. Gen. & Sp. Pl. 2 (1818) 262; Poir. in Lam., Tabl. Encycl. 3 (1823) 91; Spreng., Syst. Veg. 2 (1825) 751, p.p.; Dumort., Anal. Fam. Pl. (1829) 22; Bartl., Ord. Nat. Pl. (1830) 180; Spreng., Gen. Pl. 2 (1831) 417; Endl., Gen. Pl. 1 (1838) 633, n. 3684; Benth., Ann. Nat. Hist. 2 (1839) 445-447; Meisn., Pl. Vasc. Gen. Vol. 1 Tab. Diagn. (1840) 290, p.p. & Vol. 2 Commen. (1840) 199, p.p.; D. Dietr., Syn. Pl. 3 (1842) 596, p.p.; Walp., Repert. Bot. Syst. 4 (1845) 42, p.p.; Schauer in A. DC., Prod. 11 (1847) 572, p.p.; Walp., Repert. Bot. Syst. 6 (1847) 688; Ann. Bot. Syst. 3 (1852) 232; Miq., Fl. Ind. Bat. 2 (1858) 905, p.p.; Benth., Fl. Aust. 5 (1870) 34, p.p.; Pfeiff., Nomencl. Bot. Vol. 2, part 1 (1874) 132, p.p. & Vol. 2, part 2 (1874) 1569, 1570, 1647, p.p.; Benth. in Benth. & Hook.f., Gen. Pl. 2 (1876) 1142, p.p.; F. Muell., Syst. Cens. Aust. Pl. 1 (1882) 102, p.p.; F.M. Bailey, Synop. Qld Fl. (1883) 376, p.p.; C.B. Clarke in Hook.f. (ed.), Fl. Brit. Ind. 4 (1885) 563, p.p.; F. Muell., Sec. Syst. Cens. Aust. Pl., part 1 (1889) 171, p.p.; F.M. Bailey, Cat. Indig. & Natur. Pl. Qld (1890) 35, p.p.; Briq. in Engl. & Prantl, Nat. Pflanzenfam. 4, 3a (1895) 151, p.p.; F.M. Bailey, Qld Fl. 4 (1901) 1171, p.p.; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 382; H.J. Lam, Verbenac. Malay. Archip. (1919) 15, p.p.; Britton & P. Wilson, Sci. Surv. Porto Rico & Virgin Isl. 6 (1925) 141, p.p.; Junell, Symb. Bot. Upsal. 4 (1934) 31, p.p.; Moldenke, Lilloa 4 (1939) 292; Publ. Carnegie Inst. Wash. No. 522 (1940) 164; Moldenke in Pulle (ed.), Fl. Suriname 4 (1940) 267; Lemée, Dict. Descrip. Syn. Gen. Pl. Phan. 8b (1943) 653; Moldenke, Résumé Verbenac. etc. (1959) 278, 297, 298, 310, 393-398, 406, 460; J.F. Macbr., Fl. Peru (1960) 644, p.p.; N.T. Burb., Dict. Aust. Pl. Gen. (1963) 179; D.N. Gibson in Standl. & L.O. Williams, Fl. Guatemala (1970) 206, p.p.; Moldenke, Fifth Summary Verbenac. etc. 1 & 2 (1971) 476, 524, 525, 527, 549, 738-743, 753, 889; C.D. Adams, Fl. Pl. Jamaica (1972) 630, p.p.; Clifford & G. Ludlow, Keys Fam. & Gen. Qld Fl. Pl. (1972) 124; Moldenke, Ann. Missouri Bot. Gard. 60 (1973) 66; Lopez-Pal., Revista Fac. Farm. Univ. Los Andes-Merida 15 (1974) 55; Fl. Venezuela Verbenac. (1977) 416; Moldenke, Phytologia 41 (1978) 131; Moldenke, Phytologia 38 (1978) 230; Phytologia 39 (1978) 434; Phytologia 40 (1978) 200; Phytologia 41 (1979) 131; Phytologia 42 (1979) 199; Phytologia 44 (1979) 124, 125, 136, 138, 328, 384, 509 & 512; Phytologia 45 (1980) 36-37, 40, 339, 352, 507; Phytologia 46 (1980) 173-175, 177, 179, 508; Phytologia Mem. II, Sixth Summary Verbenac. etc. (1980) 5, 397, 419, 462, 463; Phytologia 48 (1981) 151; J.A. Baines, Aust. Pl. Gen. (1981) 219; Munir in B.D. Morley & H.R. Toelken (eds), Fl. Pl. Aust. (1983) 288; Raj, Rev. Palaeobot. Palynol. 39 (1983) 364; Jans.-Jac. in Görts (ed.), Fl. Guianas 4 (1988) 48; R.A. Howard, Fl. Lesser Antilles 6 (1989) 232, p.p.; A. Chapm., Aust. Pl. Name Index, K-P (1991) 1845-1846; G.J. Leach et al., N. Terr. Pl. Sp. Cons. Signif. (1992) 37; Verdc. in Polhill (ed.), Fl. Trop. E. Afr. Verbenac. (1992) 27.

Type: L. americana Linn., Sp. Pl. 2 (1753) 633.

Zappania Scop., Delic. Fl. & Faun. Insubr. 1 (1786) 34, t. 15.
Type: Z. odoratissima Scop. Scopoli described only one species under the genus.

Lippia Houst. ex Linn. sect. *Goniostachyum* Schauer in A. DC., Prod. 11 (1847) 574.
Type: As for *Goniostachyum* (Schauer)Small (1903).

Goniostachyum (Schauer)Small, Fl. S.E. U.S. edn 1 (1903) 1012 & 1337, based on *Lippia* sect. *Goniostachyum*.
Lectotype: G. graveolens (Kunth)Small, loc. cit. 1903.—*fide* Farr et al., Index Nom. Gen. Vol. 2, E-P (1979) 737.

Dipterocalyx Cham., Linnaea 7 (1832) 241.—*fide* Moldenke (1971, 1973), Lopez-Pal. (1977).
Types: D. hirtus Cham. loc. cit. (1832) 241 lectotype designated here; *D. glabrescens* Cham. loc. cit. (1832) 242, *syntype.*

Erect shrubs or undershrubs. *Stem* branched, woody, with simple hairs, often hirsute or tomentose. *Leaves* simple, decussate-opposite or ternate, rarely alternate or in 4's, deciduous, entire to variously toothed or lobed, exstipulate, petiolate or sessile, membranous to coriaceous, mostly penninerved. *Inflorescence* spicate or capitate, solitary or fascicled in leaf axils, or aggregate in terminal corymbs or panicles; spikes pedunculate, mostly contracted into heads or cylindric, sometimes elongating in fruit, densely-flowered; bracts conspicuous, not deciduous, decussate or many ranked, herbaceous, often folded, sometimes concave or flat, imbricate, mostly ovate or lanceolate. *Flowers* small, sessile, borne singly in the axils of bracts, often more or less 4-ranked. *Calyx* persistent, membranous, gamosepalous, ovoid-campanulate or compressed and 2-keeled or 2-winged, some 2-lipped, the rim 2- or 4-fid or 4-dentate. *Corolla* gamopetalous, hypocrateriform or infundibular, 4-lobed, zygomorphic; tube cylindric, straight or curved, slightly exserted from calyx; lobes oblique, spreading, somewhat 2-lipped, the anterior lip larger than the posterior. *Stamens* 4, didynamous, inserted at about the middle of the corolla-tube, included or slightly exserted; anthers ovate, unappendaged, the cells parallel. *Ovary* 2-locular, each locule with 1 ovule; style often short with oblique or sublateral stigma. *Fruit* dry, ovoid, surrounded by the fruiting-calyx and sometimes partially adnate to it, dividing into 2 mericarps or "nutlets" at maturity; pericarp papery or hard. *Seeds* without endosperm.

Number of species: World ± 200 species and about 60 infraspecific taxa; Australia only one naturalised species which according to Bentham (1870) was "probably introduced from South America, where it is often common, ranging from Buenos Ayres to Mexico". The much higher number of species attributed to this genus by some authors is probably due to inclusion of species of *Phyla* Lour. and *Aloysia* Ort. For instance, Howard (1989) considered it "a genus of about 400 species".

Derivation of name

The genus is named after Augustin Lippi, 1678-1701, Italian naturalist and botanist, who was killed in Abyssinia (Ethiopia) at the age of 23.

Distribution (Map 1)

According to Moldenke (1940, 1971, 1973, 1980), Britton (1965), Gibson (1970), Jansen-Jacobs (1988), Howard (1989), Verdcourt (1992) and several other authors, the genus *Lippia* is widely distributed in subtropical and tropical America, also a few species in tropical parts of the Old World. In Australia, it has been recorded from the tropical parts of Queensland and Northern Territory only.

Comments

Scopoli (1786) described a new genus *Zappania* which was later recorded by various authors as "*Zapania*", "*Zapamia*" or "*Zipania*". All are orthographic variants of *Zappania* and have been erroneously credited by some botanists to authors other than Scopoli. Several authors have recorded *Zappania* or *Zapania* as a synonym of *Phyla* Lour. Moldenke (1959), however, correctly recognised *Zappania* Scop. as a synonym of *Lippia*. In his subsequent publications (1971, 1978), he too regarded *Zappania* Scop. as a synonym of *Phyla* Lour. The present author has seen the protologue of *Zappania* and believes that the description and the plate 15 accompanying it are definitely of a *Lippia* species now called *L. alba* (Mill.)N.E. Br. ex Britton & P. Wilson.

Moldenke (1978) compared the generic descriptions given to this genus by various authors over the years (1849-1969) and concludes that "Presumably all these authors included *Acantholippia*, *Aloysia* and *Phyla* in their concept of *Lippia*". The present author has noticed this tendency in the publications by Bentham (1870), F. Mueller (1882, 1889), Bailey (1883, 1901, 1913), Schauer (1847), Briquet (1895) and many others. The majority of botanists whose concept of *Lippia* comprise an assemblage of the above named genera have not only enlarged the distribution range of the genus, but have recorded more than the actual number of species in the genus (s.str.). As mentioned earlier, the known number of taxa in the genus is about 200 species and ± 60 infraspecific taxa.

Affinities

Lippia is closely related to *Lantana* in its inflorescence being spicate, often subcapitate during anthesis and elongating in fruit, pedunculate; flowers sessile, bracteate; calyx small, inconspicuous, usually hidden by the subtending bractlets; perfect stamens 4 with anthers not appendaged; fruit composed of only 2 'pyrenes' [mericarps or nutlets]; pyrenes 1-celled and 1-seeded. Nevertheless, *Lantana* may easily be distinguished by its stem and leaves being harshly pubescent; calyx-rim truncate or shallowly toothed; corolla 4- or 5-lobed; fruit drupaceous, usually with a fleshy and juicy exocarp and hard endocarp.

According to Jansen-Jacobs (1988), "the genera *Lantana* and *Lippia* are often difficult to separate. The only difference is the structure of the fruit (berry-like or a dry 2-parted schizocarp). In herbarium material it is not always possible to know whether the fruit was somewhat fleshy or dry in vivo. If no real ripe fruits are present it is uncertain whether the 2-celled fruit is falling apart or not. Probably *Lantana* and *Lippia* comprise one genus".

There are several characters common to *Lippia*, *Acantholippia*, *Aloysia* and *Phyla*. In all these genera the calyx is 2 - 4-cleft or conspicuously toothed; corolla 4-lobed; fruit small, dry, with a hard and thin or papery exocarp, separating into two 1-celled mericarps. However, *Acantholippia* can readily be distinguished from the rest of these genera by being a more or less spinescent shrub with greatly reduced leaves and inflorescence. Of the remaining three genera, *Aloysia* differs from both *Lippia* and *Phyla* in its spikes being elongate during anthesis, with scattered and often distant flowers. Several botanists have treated *Lippia* and *Phyla* as one genus, because both these genera have spikes dense and congested during anthesis, often subcapitate, with closely imbricate flowers. Nevertheless, *Phyla* can readily be distinguished by being mostly herbaceous, with trailing or ascending stems, rooting at the nodes, sometimes somewhat woody at the base; spikes somewhat elongating in fruit; bracts cuneate-obovate or flabelliform, not 4-ranked; pubescence of medifixed hairs.

In 1839, Bentham described a new genus *Cryptocalyx* from British Guiana which he thought was closely related to *Lippia*. While discussing affinities between these two and other related genera Bentham (1839) wrote: "The genus *Lippia*, as far as I have examined it, appears best limited by Chamisso and Schlechtendal. The pericarp is thicker than in *Cryptocalyx*, and the pyrenes, though easily separable, are yet held together by it. In *Riedelia* the fruit is rather of

Lantana, and must therefore be kept distinct from *Lippia*, unless indeed this genus be joined to *Lantana*. *Dipterocalyx* appears also from Chamisso and Schlechtendal's description to be distinct. *Aloysia* is too natural a group to be united to *Lippia*, unless nearly the whole of Verbeneae be considered as one genus".

For further information see "affinities" in Munir (1993a).

	Lippia	*Phyla*	*Lantana*	*Aloysia*
Habit	spreading shrubs	prostrate herbs	spreading shrubs	spreading shrubs
Hairs	simple	medifixed	simple	simple
Spikes at anthesis	± elongate	dense	dense	elongate
Bracts conspicuous	+	+	+	-
Bracts 4-ranked	+	-	-	-
Calyx compressed, 2-keeled	+	+	-	-
Stigma	sublateral	terminal	sublateral	terminal
Fruit exocarp	thin	thin	fleshy	thin
Corolla-tube much protruding	-	-	+	+

Table 1. Table showing main diagnostic characters of the genera *Lippia, Phyla, Lantana* and *Aloysia.* (+ = present; - = absent; ± = sometimes present.)

Lippia alba (Mill.)N.E. Br. ex Britton & P. Wilson, Sci. Surv. Porto Rico & Virgin Isl. 6 (1925) 141. **var. alba**; Moldenke, Lilloa 4 (1939) 294; Moldenke, Publ. Carnegie Inst. Wash. No. 522 (1940) 165; Moldenke in Pulle (ed.), Fl. Suriname 4 (1940) 268; Moldenke, Résumé Verbenac. etc. (1959) 209, 460; J.F. Macbr., Fl. Peru (1960) 646; Sastri et al., Wealth Ind. 6 (1962) 142, fig. 49; D.N. Gibson in Standl. & L.O. Williams (eds), Fl. Guatemala (1970) 208; Moldenke, Fifth Summary Verbenac. etc. 1 & 2 (1971) 347, 890; C.D. Adams, Fl. Pl. Jamaica (1972) 630; Moldenke, Ann. Missouri Bot. Gard. 60 (1973) 70; Lopez-Pal., Revista Fac. Farm. Univ. Los Andes Merida 15 (1974) 56, fig. 10; Lopez-Pal., Fl. Venezuela Verbenac. (1977) 419, fig. 98; Moldenke, Phytologia 38 (1978) 386; Phytologia 39 (1978) 434; Phytologia 41 (1978) 131; Lopez-Pal., Revista Fac. Farm. Univ. Los Andes Merida 20 (1979) 27; Moldenke, Phytologia Mem. II, Sixth Summary Verbenac. etc. (1980) 337, 558; Phytologia 48 (1981) 156; Raj, Rev. Palaeobot. Palynol. 39 (1983) 350, 364, 396; Jans-Jac. in Görts (ed.), Fl. Guianas 4 (1988) 49, fig. 11; R.A. Howard, Fl. Lesser Antilles, Part 3 (1989) 233; A. Chapm., Aust. Pl. Name Ind. K-P (1991) 1846.

Type: As for *Lantana alba* Mill., Gard. Dict. edn 8 (1768) no. 8.

Lantana alba Mill., Gard. Dict. edn 8 (1768) no. 8; Link, Enum. Pl. Hort. Berol. 2 (1822) 126; Miq., Fl. Ind. Bat. 2 (1858) 904; Knuth, Feddes Repert. Spec. Nov. Beih. 43 (1927) 599.
Type: William Houston s.n., Campeche, Mexico, undated (BM, holotype!).

Verbena globiflora L'Her., Stirp. Nov. 1 (1786) 23, t. 12; Willd., Sp. Pl. 1 (1797) 116.—*fide* Moldenke (1940) & Lopez-Palacios (1977).
Type: L'Heritier s.n., probably collected from the Paris garden, originally from "Mato Grosso Paraguay", undated (G, microfiche!). The locality 'Mato Grosso' is in Brazil, not Paraguay.

Zappania odoratissima Scop., Delic. Fl. Faun. Insubr. 1 (1786) 34, 35, t. 15.—*fide* Moldenke (1973), Lopez-Palacios (1977).
Type: No type specimen other than t. 15 is cited in the protologue. The plate no. 15 is accepted here as the type.

Zapania lantanoides Lam., Tabl. Encycl. Méth. Bot. 1 (1791) 58. —*fide* Lopez-Palacios (1977) & Moldenke (1973).
Type Herb. Lamarck No. 246, 'Amerique meridionale', undated (P-LA, microfiche!).

Lantana lavandulacea Willd., Sp. Pl. edn 4, 3 (1800) 319.—*fide* Moldenke (1973) & Lopez-Palacios (1977).
Type: Willdenow s.n., Cat. no. 11512, from the plant growing in Berlin Botanic Garden under the name *Lantana odorata*, undated (B2 spec., microfiche!).

Verbena capensis Thunb., Prod. Fl. Cap. (1800) 96.—*fide* Moldenke (1940).
Type: No specimen cited with the protologue. In Herb. Thunb. Cat. No. 470, Uppsala, two specimens mounted on one sheet having hand-written annotation: "*Verbena capensis*". (UPS, microfiche!).

Lippia asperifolia A. Rich. ex Marthe, Cat. Pl. Jard. Méd. Paris (1801) 67; Sprengel, Syst. Veg. 2 (1825) 751; D. Dietr., Synop. Pl. (1842) 596; Walp., Rep. Bot. Syst. 4 (1845) 47; Schauer in A. DC., Prod. 11 (1847) 583; Miq., Fl. Ind. Bat. 2 (1858) 906; Kuntze, Rev. Gen. Pl. 3 (1898) 251; Baker in Dyer, Fl. Trop. Afr. 5 (1900) 280; Ram.-Gayena, Fl. Nicarag. 1 (1911) 560; H.J. Lam, Verbenac. Malay. Archip. (1919) 18; Knuth, Feddes Repert. Spec. Nov. Beih 43 (1927) 601; D.C. Raju, Bull. Bot. Soc. Bengal 23 (1969) 70, fig. 1.—*fide* Moldenke (1973) & Lopez-Palacios (1977).
Type: Not designated.

Zapania odorata Pers., Syn. Pl. 2 (1806) 140.—*fide* Moldenke (1973) & Lopez-Palacios (1977).
Type: "Habitat in America" (P, n.v.).

Lippia geminata Kunth in Humb., Bonpl. & Kunth, Nov. Gen. & Sp. Pl. 2 (1818)266; Cham., Linnaea 7 (1832) 215; Schauer in A. DC., Prod. 11 (1847) 582; Griseb., Fl. Brit. W. Ind. Isl. (1862) 495; Benth., Fl. Aust. 5 (1870) 35; F. Muell., Syst. Cens. Aust. Pl. 1 Vascul. (1882) 102; F.M. Bailey, Synop. Qld Fl. (1883) 376; C.B. Clarke in Hook.f. (ed.), Fl. Brit. Ind. 4 (1885) 563; A. Gray, Fl. N. America, 2nd edn, 2 (1886) 338; F. Muell., Sec. Syst. Cens. Aust. Pl. part 1 Vascul. (1889) 171; F.M. Bailey, Qld Fl. 4 (1901) 1172; Ram. Goyena, Fl. Nicarag. 1 (1911) 559; F.M. Bailey, Compr. Cat. Qld Pl. (1913) 382; H.J. Lam, Verbenac. Malay. Archip. (1919) 18; Standl., Trees & Shrubs of Mexico, U.S. Natl. Herb. 23 (1924) 1248; Knuth, Feddes Repert. Spec. Nov. Beih. 43 (1927) 601; Gamble, Fl. Pres. Madras, repr. edn, 2 (1956) 762; Haines, Bot. Bihar & Orissa, repr. edn, 2 (1961) 740; Prain, Beng. Pl., repr. edn, 2 (1963) 616; A. Chapm., Aust. Pl. Name Index K-P (1991) 1846.—*fide* Britton & P. Wilson (1925), Moldenke (1973) & Lopez-Palacios (1977).
Type: Humboldt & Bonpland 1140, Rio Apure, Venezuela, undated (P, microfiche!). In the protologue, information re-type reads: "Crescit in inundatis fluminis Apura juxta Santa Barbara".

Verbena odorata (Pers.)Steud., Nom. Bot. Phan. edn 1 (1821) 873.—*fide* Moldenke (1973) & Lopez-Palacios (1977).
Type: As for *Zapania odorata* Pers. (1806).

Lantana geminata (Kunth)Spreng., Syst. Veg. 2 (1825) 763.—*fide* Moldenke (1973) & Lopez-Palacios (1977).
Type: As for *Lippia geminata* Kunth.

Lippia capensis (Thunb.)Sprengel, Syst. Veg. 2 (1825) 751; D. Dietr., Synop. Pl. (1842) 596.—*fide* Moldenke (1940).
Type: As for *Verbena capensis* Thunb.

Lantana mollissima Desf., Cat. Hort. Paris, edn 3 (1829) 393.—*fide* Moldenke (1973) & Lopez-Palacios (1977).
Type: (Probably at Por FI, n.v.)

Lippia citrata Cham., Linnaea 7 (1832) 214.—*fide* Moldenke (1940, 1973) & Lopez-Palacios (1977).
Type: Hoffmannsegg s.n., "Habitat in Bookia". "E. Brasilia meridionali et acquinoctiali misit Sellow", undated (B—H.W. No. 11611, microfiche!).

Lantana lippioides W.J. Hook. & C.A.W. Arnott, Bot. Beechey's Voy. (1841) 305.—*fide* Standley (1924), Moldenke (1940, 1973) & Lopez-Palacios (1977).
Type: *Lay & Collie s.n.*, "Tepic, 54 miles from San Blas, Mexico, Dec. - Feb. 1827" (K, n.v.).

Lippia scabra Hochst., Flora 28 (1845) 68.—*fide* Moldenke (1940).
Type: Dr. Ferdinand Krauss s.n., "Natalbai, Junio 1839" (TUB, n.v.).

Lippia geminata Kunth var. *microphylla* Griseb. Fl. Brit. W. Ind. Isl. (1862) 495.—*fide* Britton & P. Wilson (1925), Moldenke (1940, 1973) & R.A. Howard (1989).
Type: Hjalmars s.n., Bahamas, Turk Islands; *Lockh s.n.*, Trinidad, undated (GOET/K, n.v.).

Lippia panamensis Turcz., Bull. Soc. Imp. Natur. Mosc. 36 (2) (1863) 201.—*fide* Moldenke (1973) & Lopez-Palacios (1977).
Type: Not designated.

Lippia lantanifolia F. Muell., Fragm. 6 (1868) 151; Moldenke, Résumé Verbenac. etc. (1959) 209; Phytologia 12 (1965) 187-242; Phytologia 13 (1966) 359; Fifth Summary Verbenac. etc. 1 & 2 (1971) 347, 892; Phytologia 39 (1978) 163; Phytologia Mem. II, Sixth Summary Verbenae. etc. (1980) 337; Phytologia 48 (1981) 177; A. Chapm., Aust. Pl. Name Index K-P (1991) 1846.—**syn. nov.**
Type: P.A. O'Shanesy s.n., Rockhampton, Queensland, undated (MEL 583660, lectotype designated here; MEL 583658 & MEL 583659, isolectotypes!); *Thozet 68 & s.n.*, Rockhampton, Queensland, undated (respectively MEL 583653 & MEL 583652—syntypes).

Zapania geminata (Kunth)Gibert, Enum. Pl. Montev. (1873) 44.
Type: As for *Lippia geminata* Kunth

Lippia lantanoides J.M. Coult., Contr. U.S. Natl. Herb. 2 (1892) 328.—*fide* Britton & P. Wilson (1925) & Moldenke (1940).
Type: "Southern Texas, along the Rio Grande to Brazos Santiago" (US, *n.v.*). The collector's name, collection number and date of collection is not mentioned in the protologue.

Lippia globiflora (L'Her.)Kuntze, Rev. Gen. Pl. 3 (1898) 251.—*fide* Moldenke (1940).
Type: As for *Verbena globiflora* L'Her.

Lippia globiflora (L'Her.)Kuntze var. *geminata* (Kunth)Kuntze, Rev. Gen. Pl. 3 (1898) 251.
Type: As for *Lippia geminata* Kunth.

Lippia globiflora (L'Her.)Kuntze var. *microphylla* (Griseb.)Kuntze, Rev. Gen. Pl. 3 (1898) 252.
Type: As for *Lippia geminata* Kunth var. *microphylla* Griseb.

Lippia javanica auct. non (Burm.f.)Sprengel: sensu A. Meeuse, Blumea 5 (1942) 68; D.C. Raju, Bull. Bot. Soc. Bengal 23 (1969) 69; p.p., *quoad syn. L. alba* (Mill.)N.E. Br. ex Britton & P. Wilson.

Typification of L. lantanifolia F. Muell.

L. lantanifolia is based on *P.A. O'Shanesy's s.n.* collection comprising at least three duplicates and *A. Thozet's s.n.* collection and collection no. 68. All these collections came from Rockhampton, Queensland. F. Mueller (1868) described these collections as a new *Lippia* species *L. lantanifolia* but did not designate the type for this taxon. It is, therefore, necessary to choose a lectotype for this name. All syntypes are preserved in Herb. MEL where F. Mueller worked and almost certainly were used by him in preparing the original description of this species. Of all the syntypes, only one duplicate of O'Shanesy's s.n. (No. MEL 583660) has been annotated as "*Lippia lantanifolia* F.v. Mueller". The specimen is particularly complete and well preserved. It is chosen here as the lectotype for this name.

Description (Fig. 1)

A strongly aromatic shrub, with procumbent-straggling branches, 0.5 - 2 (-2.4) m tall. *Stem* and branches almost cylindrical or obtusely tetragonal, virgate, strigose-hirsute mixed with small glands, 5 - 10 (-15) mm diam.; young shoots often hoary. *Leaves* opposite or sometimes in whorls of three, petiolate; lamina ovate, ovate-elliptic, ovate-oblong or almost orbicular, obtuse, crenate, often cuneate or attenuate to the base and decurrent on the petiole, sometimes more or less truncate at the base, (10-) 15 - 40 (-45) mm long, (5-) 10 - 25 (-35) mm wide, rugose, hirsute, with intermixed minute glands on the lower (abaxial) surface, the primary and secondary veins impressed above, prominent beneath, the secondary veins 5 - 7 pairs; petiole pubescent-hirsute, glandular, (2-) 4 - 10 (-15) mm long. *Inflorescence* of capitate or subcapitate spikes, pedunculate, mostly 1 [rarely 2] in the axil of upper leaves, usually much shorter than the subtending leaves or subequalling the petiole; spikes (flower-heads) first subglobose, later (at anthesis) somewhat oblong, 5 - 12 mm long, 4 - 8 mm diam.; peduncle obtusely tetragonal, hirsute with intermixed minute glands, (4-) 7 - 15 (-20) mm long, ± 1 mm diam. *Flowers* sessile, each in the axil of a bract; bracts sessile, very broadly ovate or rotund-ovate, abruptly acuminate, herbaceous, hispid-hirsute with intermixed minute glands outside (abaxially), glabrous inside (adaxially), (2-) 3 - 5 mm long, (2-) 3 - 3.5 mm wide, the outer spreading. *Calyx* shorter than the bract, 2-lobed, about one-third as long as the corolla-tube, membranous, somewhat globular, somewhat compressed not ribbed, 1.5 - 2 mm long, 1 - 1.5 mm diam., pilose and glandular outside, glabrous inside, the lobes broad and obscurely 2-toothed. *Corolla* hypocrateriform, in various shades of 'blue', 'pink', 'lilac', 'mauve', 'purple' or 'white', slightly surpassing the bract; tube cylindrical and glabrous in the lower half, much dilated upwards, pilose and glandular outside the upper dilated half, pilose inside the throat, 3 - 4 (-5) mm long, 0.5 - 1 mm diam.; lobes short, broad and nearly equal except for the anterior lobe of the lower lip which is almost twice as long as the others, the 4 smaller lobes nearly rounded, (0.5-) 1 - 1.5 mm long, 0.5 - 2 mm wide, the largest anterior lobe 1 - 2 mm long, 1 - 1.5 (-2) mm wide. *Stamens* included; filaments short, glabrous, ± 0.5 long; anthers globose, ± 0.5 mm long.

Ovary oblong-elliptic, glabrous, 0.5 - 1 (-1.5) mm long; style short, glabrous, 1 - 2 mm long; stigma oblique or sublateral, oblong-ellipsoid, 0.2 - 0.3 mm long. *Fruit* enclosed by the bract and membranous calyx, subglobose, glabrous, 1 - 2 mm diam., separating at maturity into two mericarps, each 1-seeded.

Specimens examined (collections seen: Australian 19; non-Australian 33)

AUSTRALIA: QUEENSLAND: *Bailey s.n.*, banks of the Fitzroy River in the town of Rockhampton, undated (MEL 583714); *Bisset L. 2*, 32.19 km N of Blackwater on "Cooroorah", 13.xi.1959 (BRI); *P. Black 652*, Kowanyama, Topsy Creek, -.iv.1978 (BRI); *Dallachy 252*, Rockhampton, 30.i./vii.1863 (K, MEL); *Dietrich 893, 924, s.n.*, Rockhampton, -.ii.1865 (MEL 583711, MEL 583717, MEL 583718); *Dietrich 456*, loc. cit. -.vii.1865 (MEL 583712); *Dietrich 1543*, loc. cit., -.viii.1865 (MEL 583713); *Dietrich 2060*, loc. cit., undated (MEL 583719); *Dietrich 2190*, loc. cit., undated (MEL 583715, MEL 583716); *Ritson s.n.*, Princess Charlotte Bay, -.1953 (BRI 268862); *O'Shanesy s.n.*, Rockhampton, undated (MEL 583660), lectotype of *Lippia lantanifolia* F. Muell. designated here; MEL 583658, isolectotype; *O'Shanesy s.n.* [5], loc. cit. 1.ix.1867 (MEL 583659, isolectotype of *L. lantanifolia* F. Muell.); *Thozet 68 & s.n.*, loc. cit., undated (MEL 583653 & MEL 583652, syntypes of *L. lantanifolia* F. Muell.).

NORTHERN TERRITORY: *Byrnes 1357*, c. 611 km S of Darwin, Stuart Highway, 5.ii.1969 (DNA).

UNITED STATES OF AMERICA: TEXAS: *Cameron s.n.*, Mt. Allen, Lake Hockney, Hidalgo Country, -.vi.1937 (F 899230); *Coulter 13*, Brazos Santiago, -.1889 (F 254258); *Townsend s.n.*, near Braunsville, -.x.1895 (F 375291).

MEXICO: *Calderon 1924*, Colonia San Felipe, Cosamaloapam, Veracruz, 12.vi.1969 (MO); *Jimenez A. et al. JPL-MO94*, Mercado de Abastos, Procedencia Valles Centrales, 7.ii.1986 (MO); *McKee 11001*, 66 km from Tehauntepec on Acayucan road, Oaxaca, 9.xii.1963 (CANB, NSW); *Pringle s.n.*, Matamoros, State of Tamaulipas, 8.viii.1888 (NY); *Schott 46*, Rio Bravo, -.ix/x.1885 (F).

COSTA RICA: *Liesner & Lockwood 2692*, Santa Rosa National Park, 28.vi.1977 (MO); *Liesner, Lockwood & Vega 2792*, Rio Higuerón near agricultural experimentation area near Tobago, 29-30.vi.1977 (MO).

GUATEMALA: *Ortiz 1151*, National Park, Tikal, Depto, Petén, 27.v.1970 (NY).

HONDURAS: *Molin R22161*, along Sinuapa River, vicinity of Nueva Ocotepeque, 26.viii.1968 (NY); *Murray Jr. 428*, 8 km W of Trujillo in village of San Antonio, undated (MO).

MALAWI: *Msiska 227*, Muloza Drift, Riverine forest, 12.ix.1978 (BRI, SRGH).

RHODESIA: *Gibbs Russell 1726*, ca 21 km N.W. of Marula on road to Mananda Dam, 20.iv.1972 (BRI, SRGH).

SOUTH AFRICA: *Liebenberg 8669 & 8722*, Garsfontein, Pretoria, -.ii.1977 (BRI, PRE); *Tyson 848*, King William Town, -.i.1887 (NSW, PRE).

INDIA: *Whitham s.n.*, Calcutta, -.iv.1913 (CAL, NSW).

Distribution and ecology (Map 1)

In Australia, *L. alba* is known to occur in Queensland and Northern Territory. Distribution in Queensland is chiefly around Rockhampton with only two scattered localities on Cape York Peninsula. One of the latter is near Princess Charlotte Bay along the east coast and the other near Kowanyama township along the Gulf of Carpentaria. In Northern Territory, this species has been collected from about 611 km south of Darwin along the Stuart Highway. The collector has not given the precise locality for this record but it seems to be between the townships of Daly Waters and Larrima.

Collections from outside Australia have been examined from the U.S.A., Mexico, Costa Rica, Honduras, Malawi, Zimbabwe, South Africa and India. According to Moldenke (1973), this species is "widely distributed through the West Indies, Mexico, Central America, and subtropical and tropical South America to Argentina; introduced and often escaped from cultivation elsewhere".

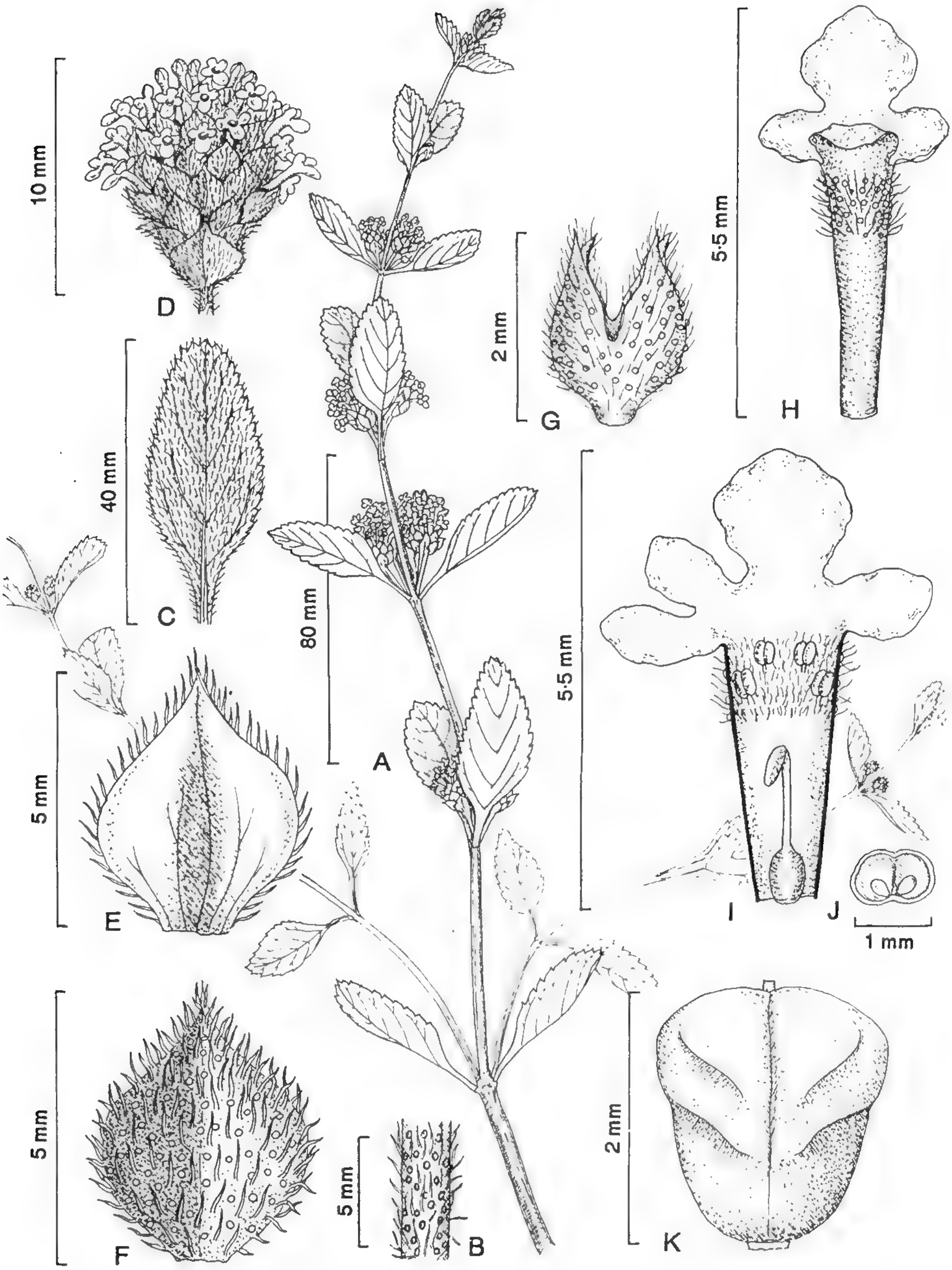
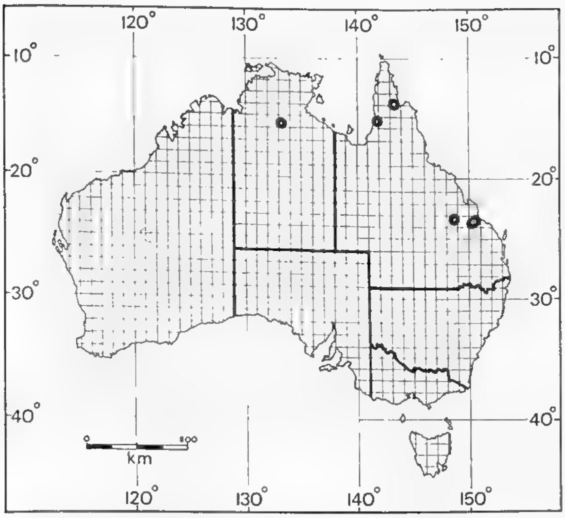


Fig. 1. *Lippia alba* (Mill.)N.E. Br. ex Britton & P. Wilson (A-J, *J.B. Ritson s.n.*: BRI 268862; K, *A. Dietrich 924*: MEL 583718). A, habit sketch of a flower branch; B, part of stem showing hairiness with intermixed glands; C, adaxial view of leaf showing hairiness; D, spike (flower-head); E, adaxial view of bract; F, abaxial view of bract; G, 2-lobed calyx; H, corolla showing glandular and pilose tube on outside; I, corolla longitudinally cut open showing androecium and gynoecium; J, transverse section of ovary; K, fruit.



Map 1. Distribution of *Lippia alba* in Australia

According to collectors' field notes, it is a strongly aromatic shrub, growing in wet places, on muddy river banks and in thickets at lower elevation. It is also known from "gravelly waste places near the sea", "in open woodland" and on "brittle clay loam soil". Sometimes it has been reported to grow on "riverbanks and sandbars". Other collectors have encountered the plant in swampy or gravelly waste places, in dry savannas and cultivated fields, on river flats, in sandy loam, clay loam, dry secondary forests and on wooded hillsides.

Comments

In a handwritten herbarium note, N.E. Brown (Oct. 1921) pointed out "that Miller & Johnston[collection no.] 94 from Margarita Island has been distributed as *Lantana alba* Mill., and feeling sure the name was wrong I compared it with Miller's type of *L. alba* at the British Museum and found that the latter is identical with *Lippia geminata* Kunth in H.B.K.!!. As Miller's name is much the older the plant should be called *Lippia alba*". The combination of *Lantana alba* with *Lippia*, however, was validated about four years later by Britton & P. Wilson (1925).

Moldenke (1973) and Lopez-Palacios (1977) included *Zapania odorata* Pers. and *Verbena odorata* (Pers.)Steud. in the synonymy of *Lippia alba*. Subsequently, Moldenke (1978) pointed out that both these synonyms rather belong to *L. javanica* (Burm.f.)Sprengel.

Meeuse (1942) maintained that *Lantana alba* Mill. [now *Lippia alba*] and *Lippia javanica* (Burm.f.)Sprengel are conspecific, therefore, placed *Lantana alba* in the synonymy of *Lippia javanica*. Meeuse (1942) claimed to have studied the type of *L. javanica*, now preserved in the Delessert Herbarium at Geneva, but there is no indication of his studying the type of *L. alba*, now preserved in the Philip Miller herbarium at the British Museum. The present author has examined the types and other material of both these taxa and found them to belong to two distinct species. Regarding distribution and the specific epithet of *L. javanica*, Meeuse (1942) states that "*Lippia javanica* has, if ever, never been collected in Java again". He further asserts that "unfortunately the specific epithet 'javanica' is quite inappropriate, for the plant does not occur in Java at all". According to present investigation, the genus *Lippia* is not known to occur in any part of Malesia.

H.J. Lam (1919) assumed its presence in the region and recorded it under the name *L. geminata* Kunth, without citing any specimen. In his notes he stated "We make mention of this species, finding it rather probable that it should occur in Malaya, since it is imported into Bengal and Australia".

Patzak & Rechinger (1967) and Stewart (1972) maintained that *Lantana alba* Mill. [now *Lippia alba*] is conspecific with *Lantana indica* Roxb. and placed *L. indica* in the synonymy of *L. alba*. They recorded *L. alba* from the North Western Frontier and Baluchistan provinces of Pakistan. According to C.B. Clarke (1885), *Lippia geminata* Kunth [now synonym of *L. alba* (Mill.)N.E. Br. ex Britton & P. Wilson] is '"so closely resembling *Lantana indica* that without fruit it is difficult to distinguish". He also stated that *L. geminata* is a widely dispersed weed of tropical America, and in the Indo-Pakistan subcontinent it is found only in the southern and

eastern part of tropical India. The occurrence of this species in Pakistan, therefore, is very doubtful and the species recorded by Patzak & Rechinger (1967) is possibly *Lantana indica* Roxb. According to Moldenke (1981), "Material of *Lippia alba* is often misidentified and distributed as *Lantana* species".

According to field notes by one collector [*P. Black 652*: BRI] this plant is "said to be the strongest smelling of the smelly herbs". Howard (1989) states that it is an "Extremely aromatic plant with leaves used widely as a tea for medicinal purposes". Gibson (1970) reports that this plant is "Grown frequently in gardens throughout Central America as a medicinal plant, a tea made from the leaves being a favourite domestic remedy for both intestinal and respiratory disturbances". A similar view is expressed by Standley (1924) who wrote that "The plant is reputed to have sudorific, antispasmodic, stomachic, and emmenagogue properties".

In addition to the above mentioned properties, Moldenke (1973) records its further medicinal use "as a pectoral, diaphoretic and as a tea for diarrhea. The leaves are used in baths in treating fever". Sastri (1962) claims that "The plant is used as a sage in cookery. Leaves are used as vegetable in Khasi hills. They are considered stomachic and nervine in parts of Brazil and Paraguay". Jansen-Jacobs (1988) states that in Guianas it is used as a "medicine for fever. The decoction of the leaves is used to calm down and is soporific".

Over the range of its distribution, this plant has been known by many different local names. In Australia, the Aborigines of Cook district in Queensland call it "Yok Kur" or "Yo Pung". A few other common names given to this plant are: "Bushy Lippia", "Sweet Verbena of the gardens", "Colic Mint", "Cullen Mint" and "Guinea Mint". According to Moldenke (1973), "over a hundred popular names have been recorded for this plant". In his notes on the genus *Lippia*, Moldenke (1978) recorded for this species a long list of vernacular names.

Various colours attributed to the corolla of this taxon could not be confirmed in the many dried herbarium specimens examined here. The variety of corolla-colours mentioned in this description are taken from collectors' field notes.

According to Moldenke (1939, 1973), the flower-bracts are "nearly as long as the corolla". The present author agrees with Grisebach (1862) and Macbride (1960) who claim that the bracts are a "little exceeded by the [violet] corolla".

In his work on the flora of Nicaragua, Goyena (1911) recognised *Lantana alba* Mill., *Lippia geminata* Kunth and *Lippia asperifolia* Rich as three distinct species. He gave detailed description of each but cited no specimens. In the present investigation, the above three taxa are considered conspecific with *Lippia alba* (Mill.)N.E. Br. ex Britton & P.Wilson.

Moldenke (1939, 1973) regarded *L. alba* as "an extremely variable and polymorphic species; with a synonymy of over 40 scientific names. A dozen subspecific entities have been proposed, some of which may be worth maintaining". A range of variation in leaf shape observed during the present investigation is shown in Fig. 2.

Very few botanists have described the fruit of this taxon. Macbride (1960) has recorded only the fruit - ["drupes"] colour as "dark violet" which the present author could not confirm in the dried herbarium specimens examined here.

Affinities

L. alba is nearest to *L. graveolens* Kunth in being an erect shrub with flower-heads usually not elongating in fruit and flower-bracts ovate to broadly lanceolate. Nevertheless, *L. alba* may easily be distinguished by its peduncles being mostly solitary [rarely two] in each leaf axil,

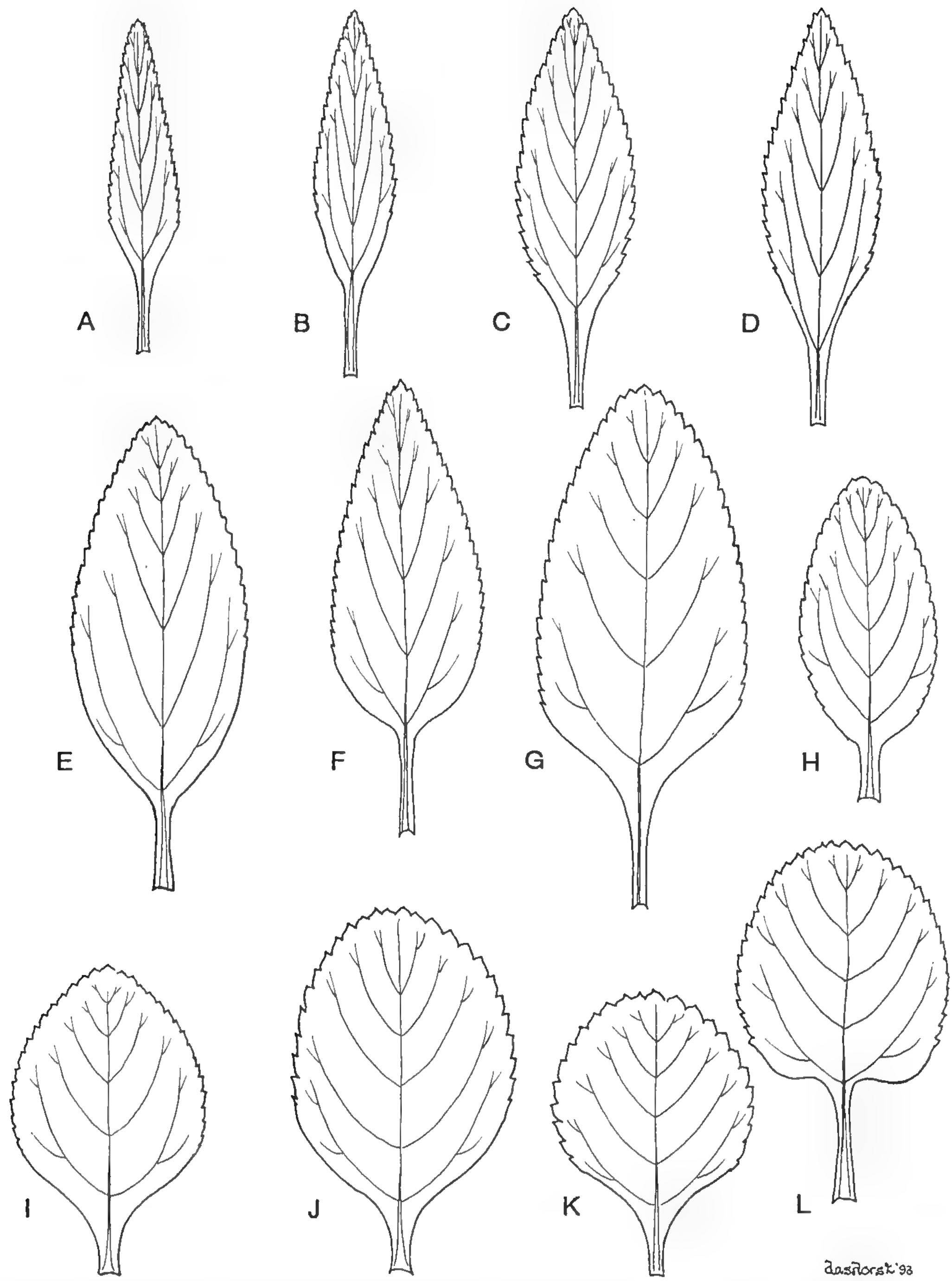


Fig. 2. Range of variation in shape of leaves of *Lippia alba* (Mill.)N.E. Br. ex Britton & P. Wilson. A, *R. Story 3419*: AD; B, *W.J. Hanekom 2267*: AD; C, *A. Schott 46*: F; D, *R.E. Murray Jr 428*: MO; E, *P. Black 652*: BRI; F, *G.M. Calderon 2228*: MO; G, *A. Traverse 1169*: F; H, *N. Byrnes 1357*: DNA; I, *J. Dallachy s.n.*: MEL 583710; J, *A. Dietrich 1543*: MEL; K, *A. Dietrich 893*: MEL; L, *F.M. Bailey s.n.*: MEL 583714.

generally as long as the petiole or longer, and flower-bracts irregularly imbricate in several ranks. In *L. graveolens*, the peduncles are 2 - 6 in each leaf axil, mostly shorter than the petioles; flower-bracts 4-ranked. There are some similarities between *L. alba* and *L. americana* L. Both species have generally 1 or 2 peduncles per leaf axil; flower-bracts imbricate, neither showy, accrescent, nor papyraceous, cuneate-obovate or rotund-ovate, abruptly acuminate or broadly obtuse and short-apiculate. However, *L. americana* can readily be identified by its scrambling, sprawling or scandent habit; leaf-blades more or less scabrous above, entire or obscurely crenate-serrate or serrulate; the trichomes conspicuously bulbous-based, the bases persistent.

Ramakrishnan (1957) considerd his newly described *Lippia unica* Ramakr. as closely "allied" to *L. geminata* Kunth [now *L. alba* (Mill.)N.E. Br. & Britton & P. Wilson]. In his remarks, he stated that "This striking species [i.e. *L. unica*] differs from its allied species *L. geminata* H.B. & K. in its solitary, axillary, condensed, subglobose spikes, elliptic to elliptic-lanceolate, acute, attenuate based leaves with upper surface villous and in its subcordate, acuminate, ciliate bracts. In *L. geminata* H.B. & K. the spikes are in one or two pairs, cylindric and elongate, the leaves ovate, subobtuse with upper surface scabrous-hispidulous hairs with papilose base and somewhat decurrent and the bracts ovate, apicute".

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A NEW SPECIES OF *CYCAS* FROM THE NORTHERN TERRITORY

S. K. Chirgwin & D. Wigston

School of Biological Sciences, Northern Territory University,
PO Box 40146, Casuarina NT 0811

Abstract

A new species of cycad from the Northern Territory, *Cycas conferta* is described.

Introduction

The first account of *Cycas* from the Northern Territory was by Robert Brown (1810) who published two species, *C. media* and *C. angulata*. Another species was added by Miquel in 1863 when he described *C. armstrongii* from material collected near the original settlement of Port Essington.

In 1978 Maconochie added a further species found only in the Northern Territory, *C. calcicola*, a distinctive species with slender, pubescent pinnae with revolute margins. The description of the new species by Maconochie was part of a review of the genus that was never completed due to his untimely death.

This genus often occupies a prominent position in the vegetation of the Northern Territory, and plants have in some instances become a specific tourist attraction. *Cycas conferta* is found in and near Kakadu National Park and it had been recognised by local botanists as different from the described species for several years. The description of this taxon thus continues the taxonomic review of the genus in the Northern Territory initiated by Maconochie.

Cycas conferta Chirgwin, *sp. nov.*

Frutex habitu palmae ad 3.5 m altus, caudice c. 120 mm diam. Folia aquamarine, 600-1050 mm longa, ad 200 mm lata. Pinnae 120-186, decurrentes in rachi, 94-105 mm longae, 3-8.5 mm late, isobilaterales, glabrae, quoque margine complantae, costa canale centrali, apex mucronatus, spina tortilli ad 1.5 mm. *Rhachis* hemispherica vel triangularis basi. *Petiolus* in sectione transversali deltatus, 0 vel 20 spinis, sed plerumque 0, furfuraceus, ferrugineus basi. *Strobilus masculus* conicus, ad 330 mm longus, 150 mm latus; pedunculus ad 35 mm longus, microsporophyllo deltato ad 25 mm longo, spinis curvatis, ad 12 mm longis, usque ad 6 series microsporophyllorum infertilium basi. *Megasporophylla* ferruginea, 120-200 mm longa, apice rhombeo, sterili, 20-65 mm longo, cum vel sine dentibus infirmibus, spina terminalis, 2-30 mm longa, pedunculus et apex sterilis ferrugineus. *Megasporae* 1-4 per sporophyllum (plerumque 2), pyriformes, rostellatae micropyle, purpureo-brunneae ubi maturae, 32-42 mm longae, 20-34 mm diamtero.

Type: Northern Territory, *G. Brown s.n.*, 21.iv.87, female plant. (holo.: DNA 29214; iso.: SYD).

Description

Palm-like shrub to 3.5 m high, trunk about 120-130 mm in diameter. *Leaves* are sea-green, 600 - 1050 mm long and 200 mm wide. *Pinnae* 120- 186 per leaf, decurrent on the rhachis, 94-104 mm long, 3-8.5 mm wide, isobilateral, glabrous, with flattened margins, midrib with central channel; apex mucronate with twisted spine to 1.5 mm long. *Rachis* subspherical to deltoid at the base. *Petiole* deltoid in transverse section; spines 0-20, but commonly 0, scurfy ferruginous at base. *Male cone* conical, to 330 mm long and 150 mm wide; peduncle to 35 mm long, microsporophylls deltoid, to 25 mm long with curved spine to 12 mm long; infertile microsporophylls up to 6 rows at base. *Megasporophyll* ferruginous, 120-200 mm long, with rhombic sterile apex 20-65 mm long, with poorly developed teeth or entire; terminal spine 2 to 30 mm long; peduncle and sterile apex ferruginous. *Megaspores* 1-4 per sporophyll (commonly

2), pear-shaped, slightly beaked at micropyle, purple-brown when ripe, 32-42 mm long, 20-34 mm in diameter. Fig. 1.

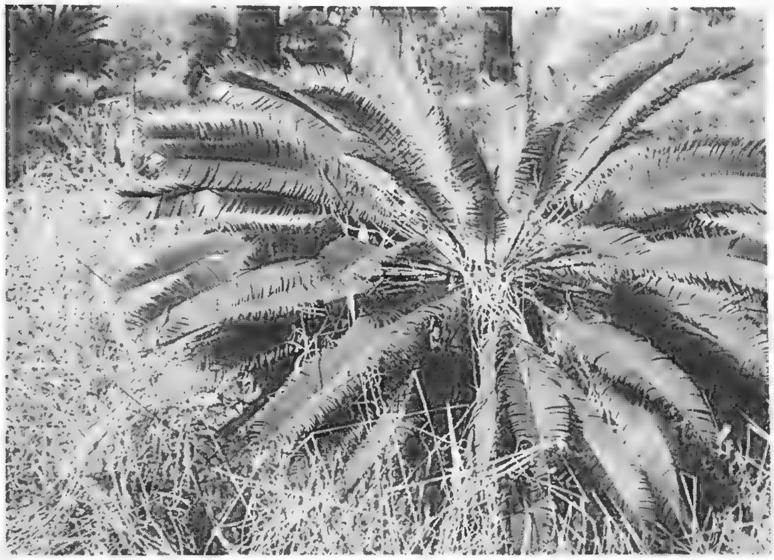

Fig. 1: *C.conferta*

Distribution: This species is found in small groups around creek systems in the Pine Creek area, completely isolated from other species of *Cycas*. It occurs in isolated groups in small numbers in and on the edge of Kakadu National Park.

Etymology: The specific epithet for this species refers to the crowded nature of the pinnae on the rachis.

Notes: Pant & Nautiyal (1963), found that only two species of *Cycas* in thirteen investigated were amphistomatic, viz. *C. comorensis* and *C. micholitzii*. All previously described species from the Northern Territory are hypostomatic, but in *C. conferta* a few scattered stomates can be found either side of the midvein on the upper pinnae surface.

The soft, sea-green coloured leaves of these plants, the crowded, isobilateral pinnae and pear shaped ovules with prominent micropyles are features that readily distinguish this taxon from all other Northern Territory species.

Conservation status: The total number of plants in this taxon is small (200-300), and therefore it must be regarded as under significant threat from mining, road making and collectors. 2RC.

Specimens examined

AUSTRALIA: NORTHERN TERRITORY: Kakadu National Park, *S.K. Chirgwin 250* (DNA), male; *S.K. Chirgwin 252* (DNA), female; *G. Brown (DNA 29215)*, sex unknown; *S.K. Chirgwin 260* (DNA), male; *S.K. Chirgwin 264* (DNA), female; *S.K. Chirgwin 300* (DNA), sex unknown.

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OTHONNA GYPSICOLA (COMPOSITAE) — A NEW SPECIES FROM NORTHERN SOUTH AUSTRALIA

R. Bates

c/- State Herbarium, Botanic Gardens, North Terrace, Adelaide, South Australia 5000

Abstract

The highly specialised species *Othonna gypsicola* is described as new and its relationship to the allied *O. gregorii* (F.Muell.)C. Jeffrey discussed. Illustrations are included.

Introduction

Record rains fell across the northern half of South Australia in the autumn of 1989. The desert was transformed; every low-lying area became a lake and between the lakes the ground was carpeted with vegetation. The author was fortunate to spend a week in the area in July of that year. Two days were spent on Copper Hills and Arckaringa Stations, an area of mesas and buttes in colourful breakaway country. The road between Copper Hills and Arckaringa passes close to large mounds of gypseous black clay, the gypsum is present as large slabs like shards of broken glass. No perennial plants grow on these mounds. The clay is deeply cracked and at least 100 mm of rain may be required to wet them properly, but a sparse scattering of ephemeral plants covered the mounds: the grass *Sporobolus carolii, Embadium johnstonii* and *Zygophyllum* species together with a glaucous, and often purple-leaved *Senecio*-like plant with large yellow flowers. This was initially mistaken for *Othonna gregorii* (F. Muell.)C. Jeffrey (*Senecio gregorii* F. Muell.) an abundant species throughout the Lake Eyre region on red sandy soils, along creek lines and even on the gibber plains. The clay-mound species, however, grew only on the deeply cracked and eroded clay, was present in large populations and did not extend to any adjacent different soil type. Collections were made and hundreds of collections of *Othonna gregorii* examined in the State Herbarium of South Australia. Not one specimen similar to the clay-mound taxon was located. Examination showed that it differed in many respects from *O. gregorii*, and it did not closely approach any other species. Hence the Copper Hills — Arckaringa plants are here described as a new species.

Othonna gypsicola R. Bates, *sp. nov.*

ab *O. gregorio* involucello longiore globulariore, lobis expansis discorum et acheniis fuscatis falcatioribus papillis serialibus pellucidis pappoque barbellato differt.

Type: Gypseous clay mounds between Copper Hills and Arckaringa, South Australia, 8.vii.1989, *R. Bates 19171*; (holo.: AD; iso: K, MO, NSW, PERTH).

Glabrous, deep-rooted ephemerals, erect to 30 cm high, little branched. *Leaves* leathery, purplish or greenish, glaucous, obovate to obovate-oblanceolate, 1-4 × 0.8-2.2 cm, entire, sessile, obtuse to sub-acute, somewhat imbricate. *Inflorescence* single or paired, terminal; peduncles 3-10 cm long, with few leaves. *Involucre* large, globular, 2-4 cm diam., ecalyculate, of 5-10 segments, at least partly connate, margins smooth, membranous, apices acute, ciliate; receptacle convex. *Ray florets* 8-10; ligules 6-10, ca 3 × 1 cm, yellow, with 4-6 red nerves. *Disc florets* ca 50, tubular, 5 × 1 mm, 5-lobed; lobes ca 1 × 1 mm, spreading or recurved. *Styles* shortly bifid on ray florets, with 2 mm long lobes on disc florets; stigma a short bristle of fused papillae. *Anther* obtuse, deltoid, filaments largely fused. *Achenes* sub-cylindrical, falcate, 8 × 2 mm, dark brown, 10 ribbed, ribs covered with rows of pellucid papillae to 0.3 mm long; a persistent pappus of stout, barbellate, white bristles.

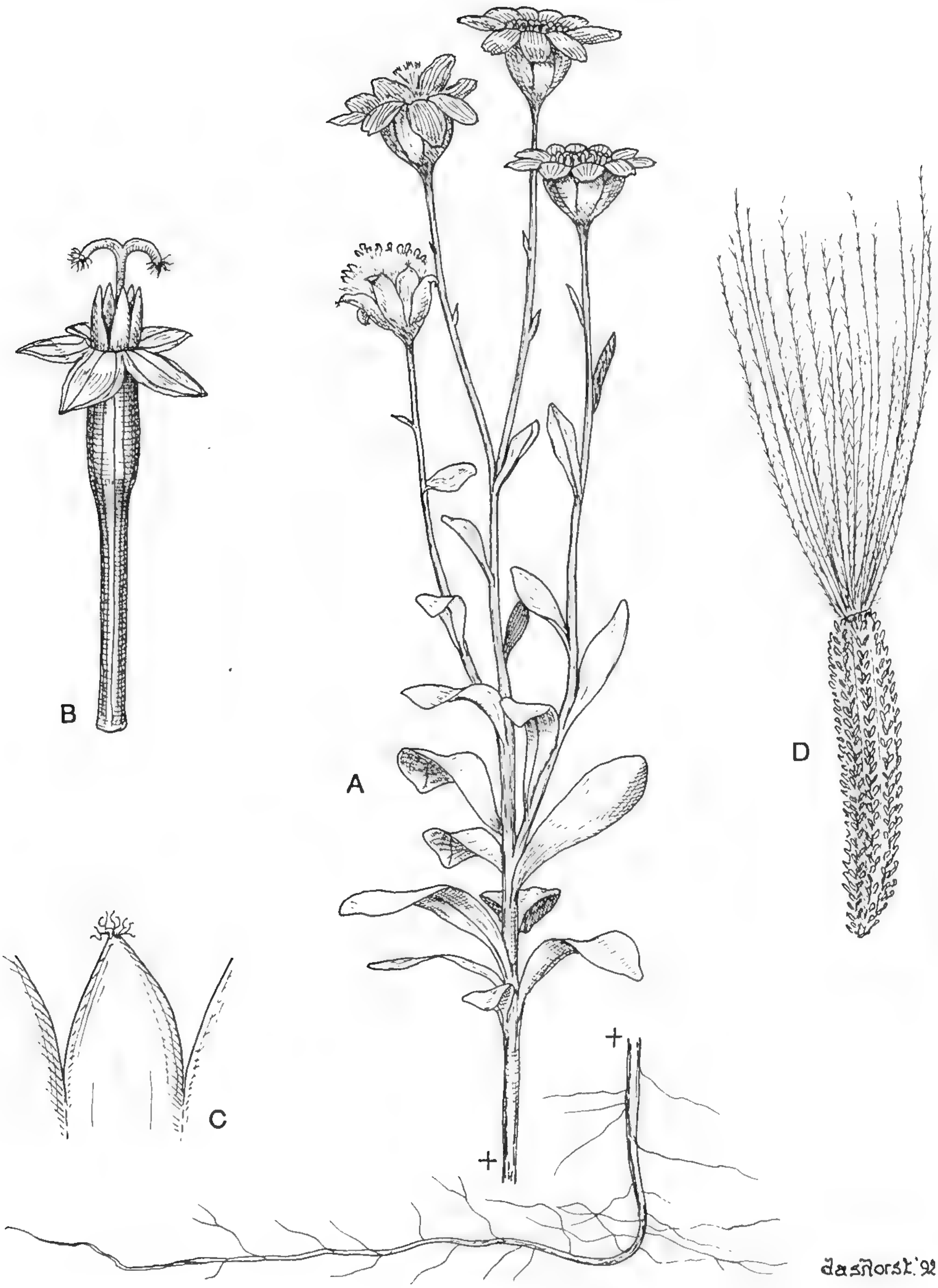

Fig. 1. *Othonna gypsicola*. A, whole plant ×½; B, disc floret ×10; C, apex of involucre segment showing cilia; D, single achene ×10. (From *R. Bates 19171,* holo.: AD).

Restricted to mounds of black gypseous clay with exposed gypsum shards, at the base of breakaways between Copper Hills and Arckaringa homesteads west of Oodnadatta, South Australia (LE). This area receives probably less than 150 mm mean annual rainfall of very erratic nature such that *O. gypsicola* may not germinate frequently and, judging from the lack of collections, perhaps only grows after exceptional falls of rain. *O. gypsicola* did not appear in 1990 (C. James, pers. comm.). Flowers appear 2-4 months after rain.

Othonna gypsicola differs from *O. gregorii* in branching above the ground, in the different position of the leaves, the larger more globular involucre with its fewer and less connate sepals with their fimbriate apices, the larger ligules, the spreading lobes of the disc florets, the longer style branches, the darker more distinctly falcate achenes with their distinctive rows of pellucid papillae and the coarser more distinctly barbellate pappus bristles. *O. gregorii* also occurs on Copper Creek Station where it is restricted to isolated plants along creek lines in sandy soil.

Leaves obovate to obovate-lanceolate, achenes with distinct rows of pellucid papillae .... *O. gypsicola*
Leaves broad-linear, achenes densely pubescent .... *O. gregorii*

Generic placement of Othonna gregorii and O. gypsicola

Othonna gregorii (F. Muell.)C. Jeffrey was until 1986 *Senecio gregorii* but had long been considered discordant in *Senecio* (Lawrence & Belcher 1986) on the basis of its glabrous, fleshy leaves, ecalyculate and largely connate involucre among other characters. However, *O. gregorii* and *O. gypsicola* could be considered discordant in *Othonna* which is a largely South African genus of shrubby or tuberous perennials with female sterile disc florets and undivided styles. It is, however, superficially very similar to the fleshy, glabrous leaved Australian, perennial, arid-land shrubs *Senecio magnificus* and *S. megaglossus* which also have a largely ecalyculate involucre.

Etymology: gypsicola, gypsum loving, in reference to the specialised habitat.

Conservation status: rare and not conserved but under no threat as it is not grazed.

Additional collection

SOUTH AUSTRALIA: gypseous clay mounds and clay wall of dam on Copper Hills and Arckaringa Station, 7.vii.1989, *R. Bates 19816* (AD).

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J. Adelaide Bot. Gard.. 15(2): 153-157 (1993)

SPYRIDIUM TRICOLOR (RHAMNACEAE), A DISJUNCT NEW SPECIES FROM THE GREAT AUSTRALIAN BIGHT

W.R. Barker

State Herbarium of South Australia, Botanic Gardens, North Terrace, Adelaide, South Australia 5000

B.L. Rye

Western Australian Herbarium, Department of Conservation & Land Management, P.O Box 104, Como, Western Australia 6152

Abstract

This new species is described from Western Australia and South Australia from mallee vegetation on shallow soil overlying limestone. The occurrences in the two states are over 650 km apart and separated by the Nullarbor Plain. In comparison with other *Spyridium* species with the same fruit type, *S. tricolor* can be distinguished from its South Australian and eastern states congeners by the very large size of the stipule-like bracts which encircle the unit inflorescences, and amongst the Western Australian species by its almost circular leaves with flat to incurved rather than recurved margins.

On the basis of the collections in the State Herbarium of South Australia and the Western Australian Herbarium, the following species was first collected in South Australia in 1926 from Koonibba, near Ceduna on the eastern edge of the Great Australian Bight, and in Western Australia in 1966 from near Mt Ragged in Cape Arid National Park. It was recognised as distinct independently by the two authors.

Spyridium tricolor W.R. Barker & Rye, *species nova*

Spyridium spadiceum var. *calvescens* auct. non (Reiss.)Benth.: R.F. Parsons, Trans. Roy. Soc. S. Austral. 94 (1970) 239.

Spyridium spadiceum auct. non (Fenzl)Benth.: E.C. Nelson, J. Roy. Soc. W. Austral. 57 (1974) 110, partly (as to AD duplicates of *Parsons 144, 159, 190*).

Spyridium sp.: W.R. Barker in J.P. Jessop, List Vasc. Pl. S. Austral., edn 2 (1984) 38; W.R. Barker in J.P. Jessop, List Vasc. Pl. S. Austral., edn 3 (1989) 63

Species nova inter species orientales bracteis maximis brunneis circa fasciculos florum unica, inter species occidentales fructus eosdem ferentes foliis marginibus denique planis usque incurvatis differt.

Holotypus: *P.G. Wilson 5940*, 20.vii.1967, P[oin]t Dover, Great Australian Bight, Western Australia, PERTH. *Isotypi*: AD, CANB.

Erect dense rounded *shrub* 0.3-1.5 m high, with a persistent dense indumentum on the stems, rachises and leaves and leaf-like bracts on petioles and underside of the blade, consisting of antrorse to spreading wavy hairs c. 0.3 mm long, initially ferruginous, giving young branch tips a characteristic rusty appearance, turning grey. *Stipules* ovate, 3-5.5 mm long, caudate, keeled, dark brown soon turning dark grey, very shortly pubescent, mainly along midline towards base, persistent after leaves have shed, but with a fragile tip. *Leaves* with *petiole* 3-5 mm long; *blade* thick, at first conduplicate, at maturity almost flat but with the upper midrib impressed, broadly elliptic to circular, 8-13 × 7.5-12 mm, the base and apex rounded, sometimes slightly emarginate, the margins usually flat, sometimes incurved, the upper surface pale to mid green,

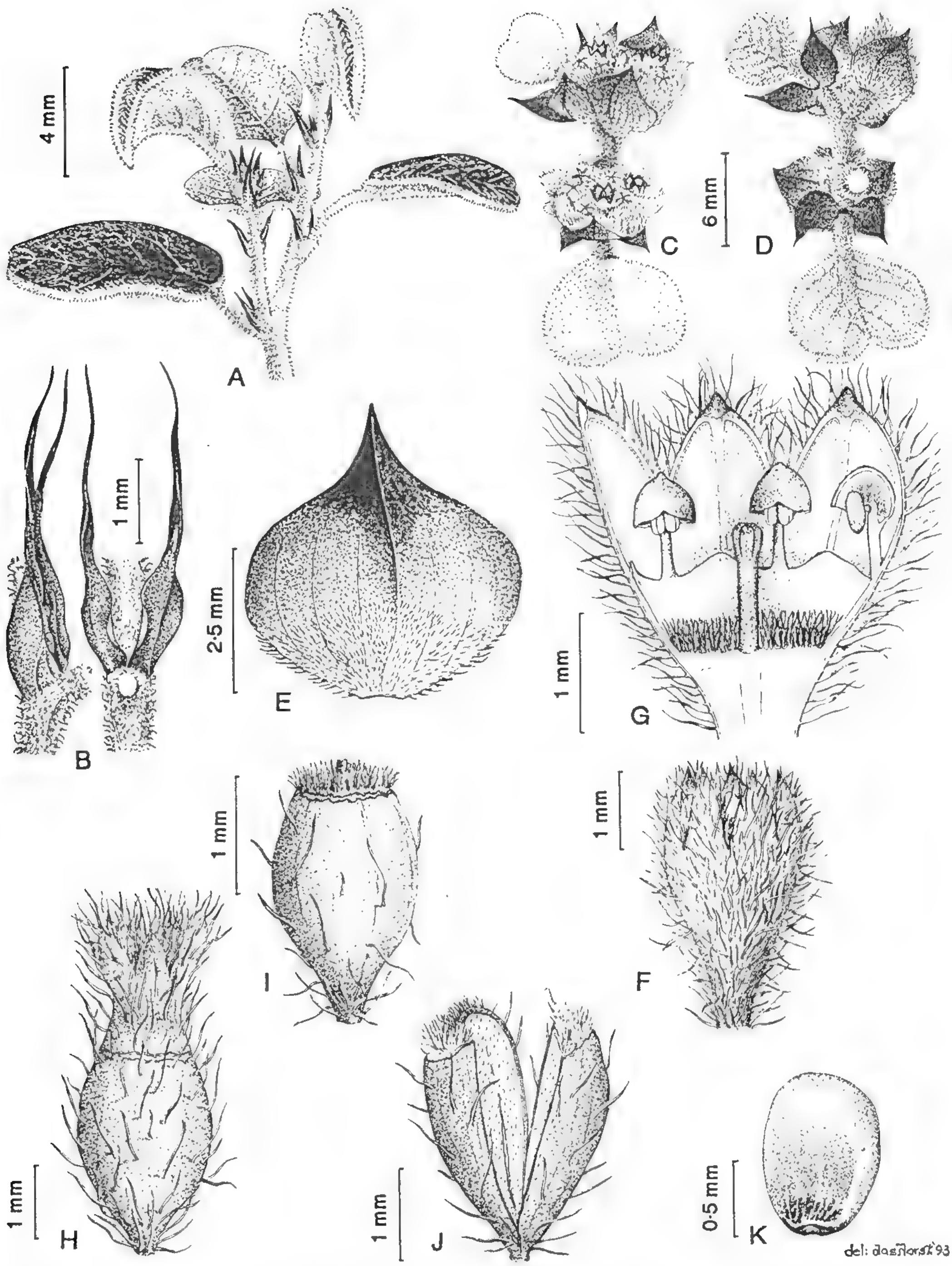

Fig. 1. *Spyridium tricolor.* A, branch apex; B, pair of stipules from side and below; C, compound inflorescence from above and, D, below; E, involucral bract; F, flower; G, flower in longitudinal section; H, I, fruit with perianth and with perianth detached; J, dehiscent fruit; K, seed. (A-B, *Croft 4;* C-G, *Royce 10095;* H-K, *Wilson 5940*)

appearing glabrous but with minute hairs c. 0.1 mm long, the lower surface with 4-6 lateral veins on each side. *Inflorescence* usually terminal, compound, on a once forked rachis, the forks bearing 1-3 dense unit inflorescences of 12-20 sessile to subsessile flowers and terminated by a bistipulate leaf-like bract densely cream tomentose above; *unit inflorescences* surrounded by an imbricate ring of involucral bracts; *involucral bracts* broadly or very broadly ovate, 4-6 mm long, acuminate, dark brown turning dark grey, pubescent like the stipules, often splitting and the tip breaking off as the buds and fruits develop. *Flower* densely tomentose; *floral tube* 1.2-1.5 mm long, with hairs antrorse, over 1 mm long; *sepals* ovate, 1-1.3 mm long, with spreading white hairs less than 1 mm long; *petals* c. 0.7 mm long, hooded, enclosing the anthers; *disc* adnate to the floral tube, glabrous, with 5 depressed ovate lobes c. 0.4 mm wide alternating with the stamens; *ovary* inferior, the flat summit densely covered with erect white hairs c. 0.5 mm long; *style* c. 1.5 mm long, glabrous, topped by 3 small stigmatic lobes. *Fruit* a schizocarp, obovoid and topped by the floral tube and perianth which apparently persist until dehiscence, dark brown, glabrous but for scattered deciduous hairs (originally on the base of the floral tube), white-pubescent on the finally exposed summit, splitting to the base into 3 1-seeded or infertile cocci; *cocci* compressed obovoid-ellipsoid, c. 2 mm long, apparently shed intact, the white papillose membranous wall with an adaxial longitudinal suture; *seed* compressed, broadly elliptic in outline, slightly curved so that concave in adaxial view, c. 1-1.4 × 0.8-1.2 mm, smooth, pale to mid yellow-brown, at the base black within showing through the hyaline testa: *caruncle* apparently absent. (Fig. 1).

Distribution & ecology

S. tricolor is known from two regions over 650 km apart on either side of the Great Australian Bight, separated by the Nullarbor Plain (Fig. 2). It extends from Cape Arid National Park north-eastwards to near Eyre in Western Australia, while in South Australia it is confined to locations in the vicinity of Koonibba which is about 25 km north-west of Ceduna on north-western Eyre Peninsula.

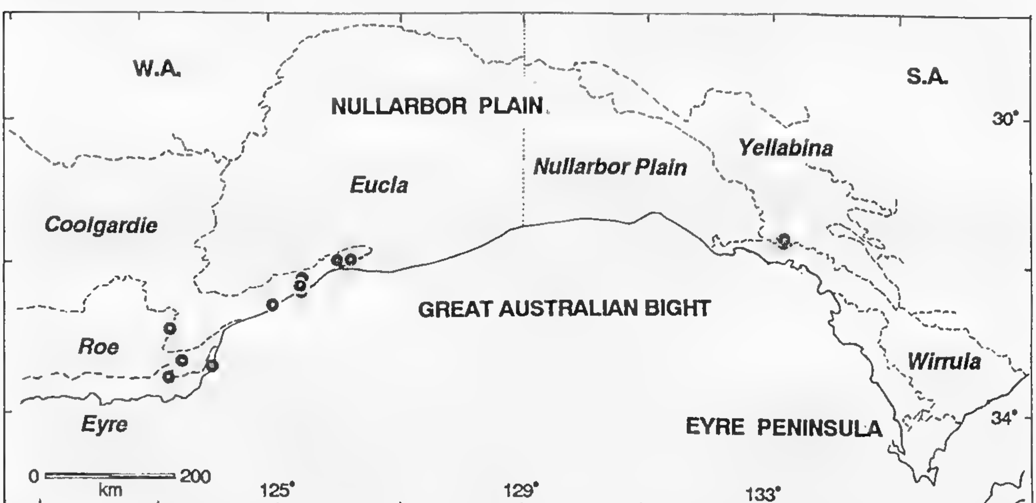

Fig. 2. Distribution of *Spyridium tricolor* in relation to the Beard (1980) phytogeographic regions of Western Australia and the Laut et al. (1977) environmental associations of South Australia. (These regions and associations are italicised).

In Western Australia populations appear to be restricted to sand, loam or sandy clay over limestone substrate; they are often noted as occurring in mallee communities, once (*Archer 1411927*) as localised with a *Triodia* sp.

In South Australia they apparently usually occur in similar habitats in the Wirrula Environmental Association of Laut et al. (1977; Fig. 2) on shallow sand to sandy loam over limestone rubble or sheets (calcrete), in *Eucalyptus dumosa* low open forest sometimes with *E. oleosa* (*Croft 3*), in broad openings of low open *Casuarina pauper - Myoporum platycarpum* woodland between denser mallee *Eucalyptus* woodland (*Croft 4*), and in *E. gracilis - E. oleosa* open scrub (*Croft AD 99050223*), this last extending into the adjacent Yellabina Association in *E. incrassata - E. yumbarrana* open scrub on red siliceous sand dunes.

Flowering occurs throughout the year.

Conservation status

Only two populations are known to exist today in South Australia, about 10 km apart, both NW of Ceduna in the Hundred of Catt and between Koonibba and Penong. These possibly come from the same general area as the only other records from the State over 60 years ago. Mr T. Croft (pers. comm., June 1993), who relocated the species, believes that it may be confined to the mallee vegetation restricted to this area which is characteristically richer than that further to the west. While finding over 50 plants at one location (*Croft AD 99050223*), at the other he saw only five plants despite a search (*Croft 3, 4*). It is possible that South Australian populations are under threat, but this can be confirmed only when the region is more closely surveyed. In the meantime the two areas where *S. tricolor* is known to exist have been placed under Heritage Agreements to prevent land clearance.

In Western Australia *S. tricolor* is apparently not threatened. At least ten populations are known, most occurring in conservation reserves. The species extends for over 300 km. The number of plants in each population has rarely been recorded, but populations with of the order of 100 or more plants occur north-west of Mt Ragged (*Archer 1411927*) and at Gegelup (G.P. Craig, pers. comm. June 1993).

Notes

The genus *Spyridium* and its closely allied genera are in need of revision (Barker 1987). Although *S. tricolor* appears to have no very close relatives, it clearly belongs to the genus *Spyridium*, matching the fruit type and other diagnostic characters that have generally been used to delimit the genus. However, it may be unique in the genus in that it appears a caruncle is either absent or atypically smooth. The limited availability of fruits (confined to the type) and their immaturity precluded further investigation.

Among the South Australian and eastern state species *S. tricolor* is readily separated by its very large brown bracts which encircle the units of the compound inflorescence. No other species approaches these in size. Among the Western Australian species with the same fruit type it can be distinguished by its almost circular leaves with margins flat to incurved rather than recurved. Most specimens of the new species in PERTH had been misidentified as *S. rotundifolium* F.Muell., a species which overlaps in range and has leaves and bracts of similar size. The resemblance is superficial, however, as *S. rotundifolium* appears to belong to a different genus; its fruit is of the type found in *Pomaderris*, being half-inferior and having cocci with a fenestre. It also differs in many other characters, including its recurved leaf margins and shortly but distinctly pedicellate flowers.

S. tricolor apparently joins taxa with a disjunct distribution between south-western and south-eastern Australia (Green 1965, Parsons 1969). While the intervening region has not been thoroughly surveyed, the complete absence of herbarium specimens from the environmental regions of Beard (1980) and Laut et al. (1977) which equate to the Nullarbor Plain (Fig. 2) indicate that the disjunction is likely to be real. Parsons (1970) and Nelson (1974) noted this species (confused with "*S. spadiceum*") as a component of the calcifuge flora of the Roe Plain, which forms a strip between the calcareous Nullarbor plateau and the coast and is isolated from similar floras west of the Nullarbor Plain. The Nullarbor Plain has acted as a barrier to migration by calcifuge species since the late Tertiary but may have been circumvented by migration to the south along a coastal plain exposed during extended periods of low sea levels (Nelson 1981).

Etymology

The epithet derives from the Latin *tres*, meaning three, and *color*, coloured, referring to the distinctly three-coloured leaves, the undersurface of which is initially ferruginous but becomes grey with maturity, contrasted with the pale to mid green upper surface visible once the young leaves have unfolded.

Specimens examined

WESTERN AUSTRALIA. EYRE: *G.F. Craig 2554*, 21.iv.1993, 'Gegelup' Lake, near Israelite Bay, PERTH.—ROE: *R.D. Royce 10095*, 4.xii.1971, W edge of Reserve, S of Mt Ragged, Balladonia Road, Cape Arid National Park, PERTH; *E. Wittwer 7392*, 17.i.1966, c. 6 miles SW of Mt Ragged, PERTH; *J.W. Wrigley 68 5273* , 1.xi.1968, 40 km toward Balladonia, from road camp, 144 km E of Esperance, PERTH (ex CBG).—COOLGARDIE: *W.R. Archer 1411927*, 14.xi.1992, ca. 55 km [N]NW of Mt Ragged, AD, PERTH; *M.J. Fitzgerald s.n.*, 24.viii.1983, 32.5 km S of Caiguna via Baxter's Memorial track, PERTH 01280082; *G.J. Keighery 7195*, 3.iv.1984, 10.2 km N Eyre, on top of Hampton Tableland, PERTH; *G.J. Keighery 7290, 7291*, 3.iv.1984, 10 km N Eyre on Hampton scarp face, PERTH; *G.J. Keighery & J.J. Alford 520*, 14.xii.1985, Toolinna Cove campsite, 73 km SW of Caiguna, PERTH; *R. Parsons 144*, 1.xii.1967, Ca. 18 km SSW of Cocklebiddy, AD (ex MELU); *R. Parsons 159*, 1.xii.1967, 23 km SSW of Cocklebiddy, AD (ex MELU); *R. Parsons 190*, 2.xii.1967, ca. 27 km S of Caiguna, AD (ex MELU); *P.G. Wilson 5940* (see Type citation); *E. Wittwer 1975*, 11.xi.1976, 17 km S Caiguna, on Baxter Memorial Road, PERTH.

SOUTH AUSTRALIA. EYRE PENINSULA: *J.B. Cleland s.n.*, 22.viii.1928, 8 miles W of Koonibba, AD96601630; *T. Croft 3*, 29.v.1991, eastern boundary of Section 15 Hundred of Catt, 16½ km NW of Koonibba, 2 km NE of White Well Corner, AD; *T. Croft 4*, 30.v.1991, Section 15 Hundred of Catt, 16½ km NW of Koonibba, 1½ km NNE of White Well Corner, AD, CANB, PERTH; *T. Croft s.n.*, 24.x.1990, northern part of Section 10, Hundred of Catt (northern boundary of Hundred), 23 km NE of Penong, AD 99050223; *Rev. C. Hoff s.n.*, viii.1926, Koonibba, AD97744369.

Acknowledgements

Mr Tim Croft of the Native Vegetation Management Branch, Department of Environment and Land Management, South Australia is thanked for his successful search for further locations of the species. We are also grateful to Mr Gilbert Dashorst for his careful illustration.

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BOOK REVIEW

Acacias of South Australia, revised edition. D.J.E. Whibley & D.E. Symon (1992). pp. 328, 8 figs., 122 plates. (Government Printer, South Australia). Softbound. $A39.95.

One of the most useful regional treatments of the genus has been David Whibley's 1981 book with the same title and it has set the pattern for this revised edition by David Symon. The revision includes the 97 species of the first edition with an additional 25 recognised for the State since its publication. The species treatments have the same structure: the correct Latin name, common name(s), bibliographic details, plant description, flowering time, distribution and notes on cultivation and affinity with other taxa. Each species treatment is on two facing pages, one of which is occupied by line drawings and (mostly) habit photographs, the other page by the description and a distribution map of occurrences in South Australia.

The first difference one notes in the revision is the additional nine pages of explanatory text that present summaries of *Acacia* biology, seeds and germination, seed dispersal, seedlings, hair types, phyllodes, cyanogens, gums, wattle bark, pollen and pollination, pigments, species distribution, chemotaxonomy, mistletoes that parasitise wattles and finally the taxonomy of the genus. These paragraphs are well-larded with literature references for those who wish to have further details.

The new edition is in a substantially larger format with a third more pages. Individual species treatments include notes on revisionary work since 1981, as well as data concerning additional uses by Aboriginal people, chemistry, etc., right up to 1991. It should be noted that recent changes in the nomenclature of the Mulga (*A. aneura*) group have been adopted but a competing taxonomy presented by Les Pedley, if adopted, would necessitate a change in the name of *A. ayersiana*. The original maps have been updated and the illustrations enlarged by about 20%. One of the most attractive parts of the new book is that the photographs in the original, many of which were poorly printed, have been replaced by high-quality colour photographs, commonly made of the plant in the field to show its habit and habitat. The same line drawings are used but with much improved definition because the lines appear much darker. Unfortunately, the line drawing of *A. pulchella*, which was not in the original, shows once-pinnate leaves instead of the bipinnate ones that characterise it.

Gardeners, nurserymen and other users will continue to applaud the simplicity of the descriptions which use a minimum of technical terms and these are defined in a glossary at the end of the volume. This is a thoroughly authoritative handbook in terms of its taxonomic coverage, botanical accuracy and clear presentation. It is well worth the price to those concerned with South Australian wattles.

R.S. Cowan & B.R. Maslin
Western Australian Herbarium

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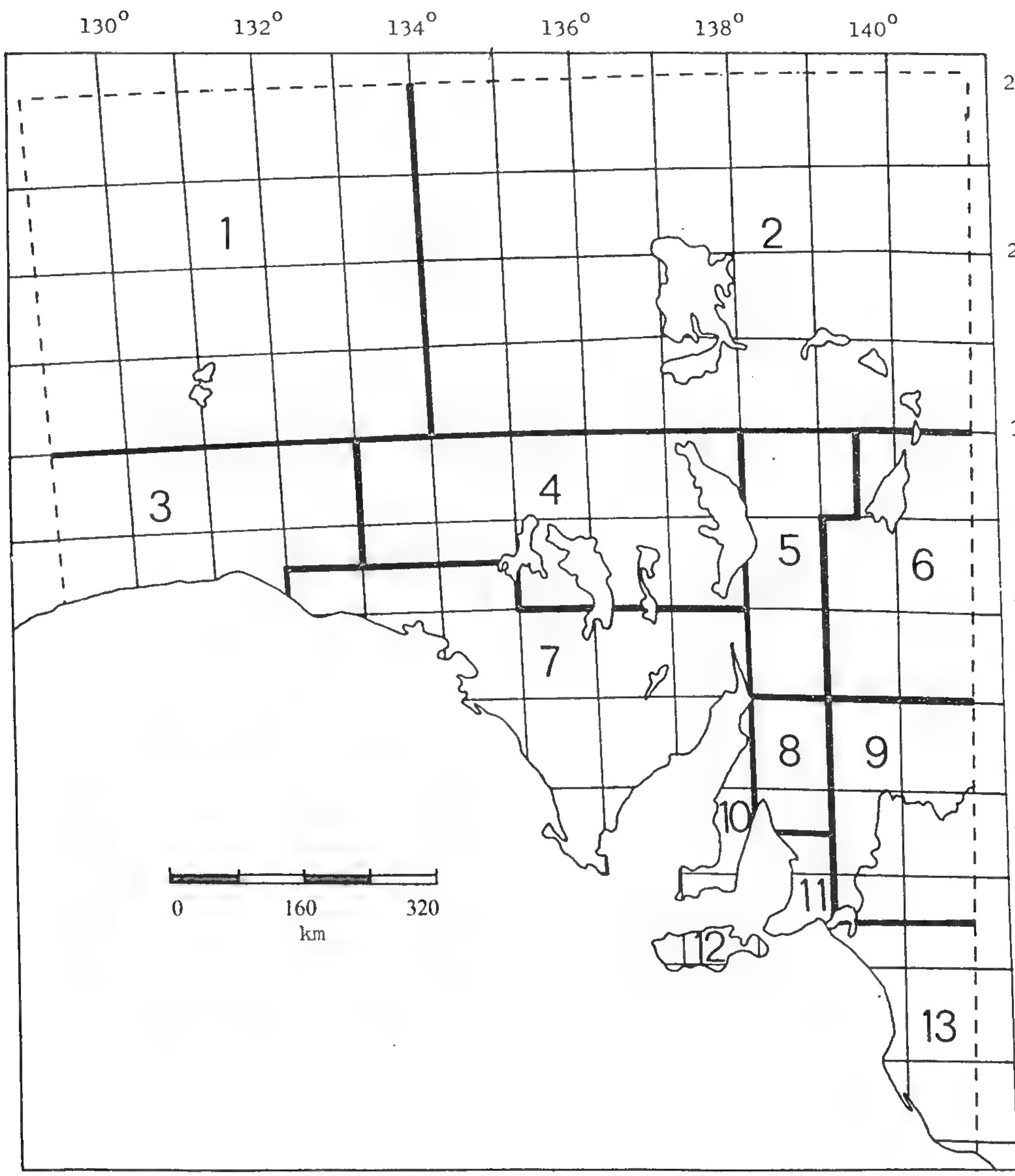
1. North-western
2. Lake Eyre
3. Nullarbor
4. Gairdner-Torrens
5. Flinders Ranges
6. Eastern
7. Eyre Peninsula
8. Northern Lofty
9. Murray
10. Yorke Peninsula
11. Southern Lofty
12. Kangaroo Island
13. South-eastern



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